THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LIII. No. 1355.] LONDON, APRIL 30, 1889. [41ST YEAR. Price 6d.

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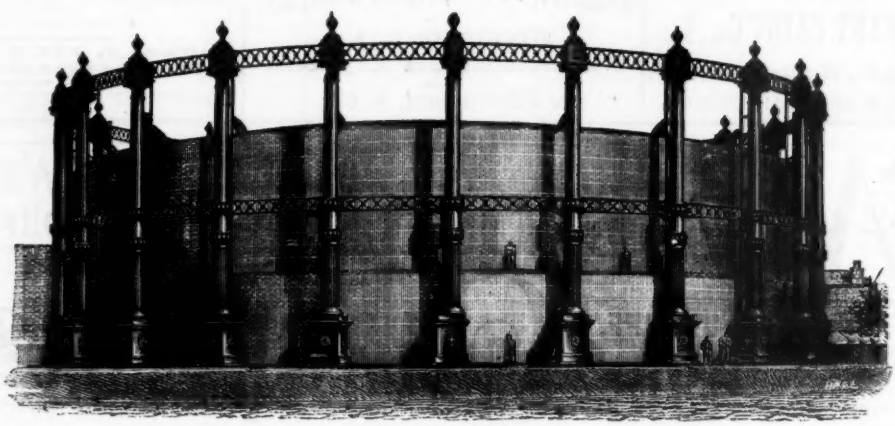

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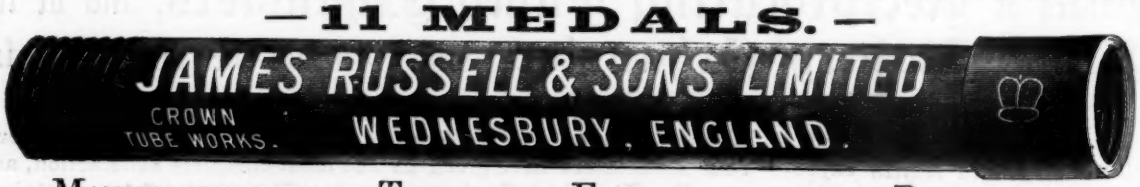

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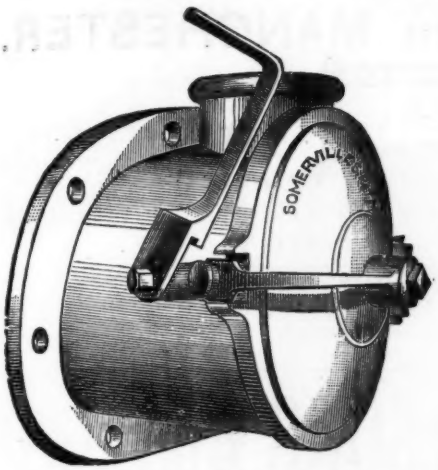

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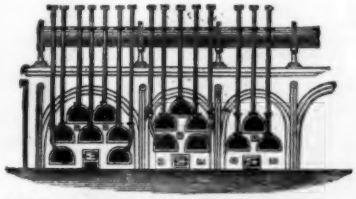

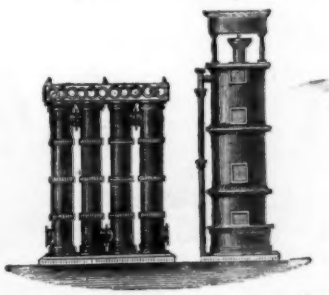

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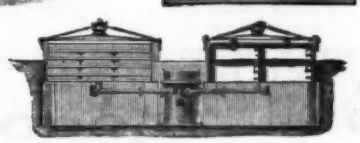

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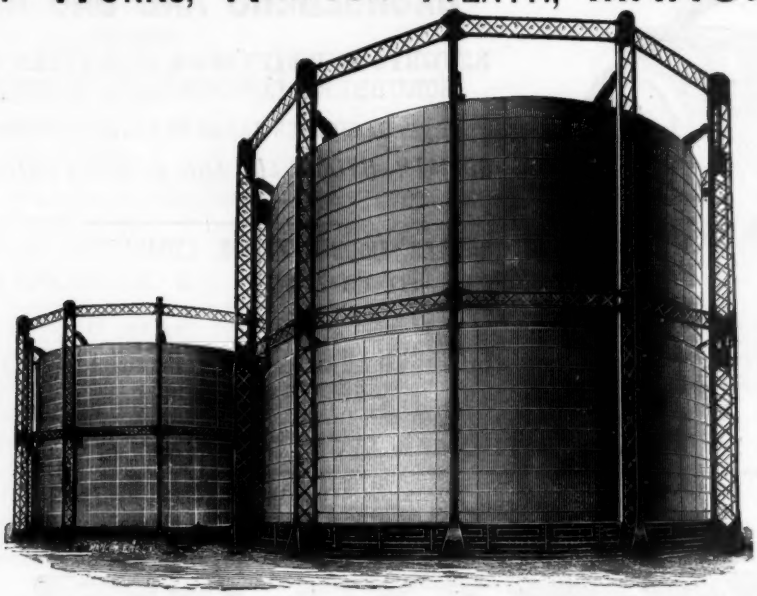

Illustration showing view of two Telescope Gasholders, each 65 feet diameter by 48 feet high, recently erected by Messrs. R. and J. Dempster, in Tanks previously occupied by Single-lift Holders 20 feet deep. The Tanks were made 4 feet deeper, by adding a Tier of Cast-Iron Plates, prepared with suitable Flanges, to meet the Brickwork of a Brick and Puddle Tank. The storeage capacity was thus increased nearly 150 per cent. at comparatively little outlay.

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MADE in SIZES
2 Man to 100 HP.

GAS-ENGINES
COMBINED
WITH
PUMPS
FOR
TOWNS SUPPLY,
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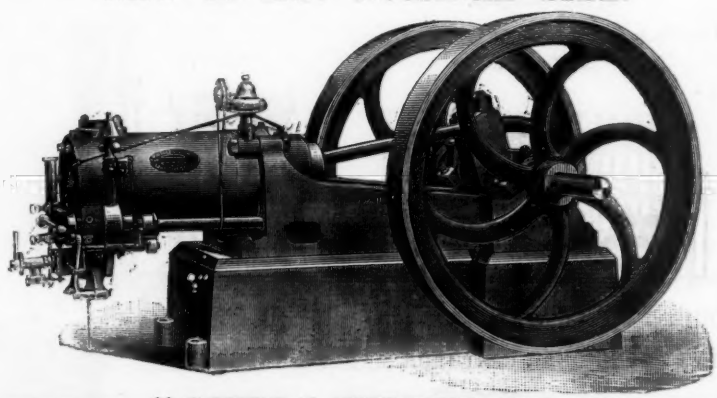

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VERTICAL
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HORIZONTAL
TYPES.

ENGINES
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HOISTS, PUMPS,
DYNAMOS, &c., &c.

Largely used for
EXHAUSTING,
PUMPING,
COKE CRUSHING,
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&c., &c.

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PATENT "STANDARD" WASHER-SCRUBBER,

FOR

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EXTRACTION OF AMMONIA FROM GASES

FROM COKE-OVENS AND BLAST-FURNACES.

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EQUAL TO A

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Horseferry Road, Westminster, S.W.,

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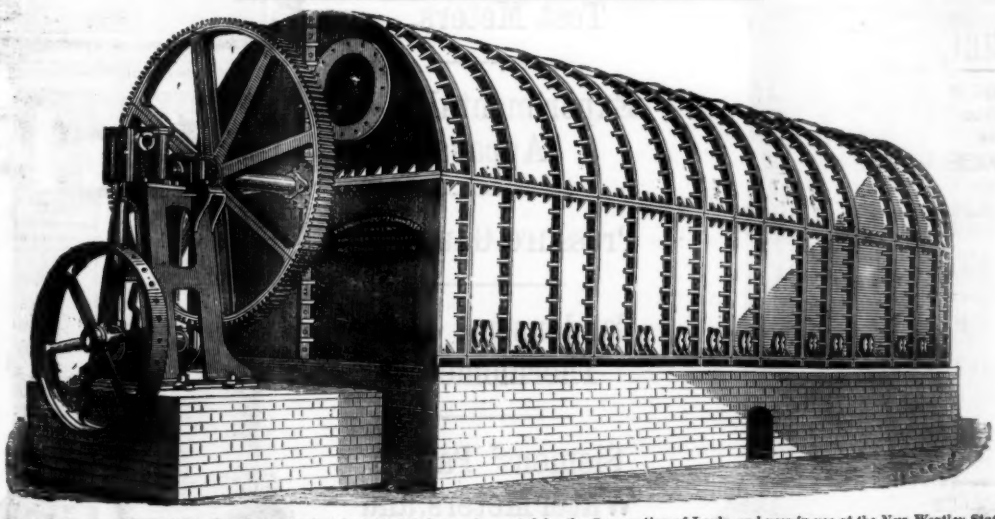
SIDNEY HERSEY, Esq., Secretary.

KIRKHAM, HULETT, AND CHANDLER, Limited.

Dear Sir,—In reply to your letter of yesterday's date, I beg to say that the Washer-Scrubbers that you have supplied us with at our several Works continue to give every satisfaction.—I remain, yours truly,

(Signed) G. C. TREWBY.

Testimonials as to Efficiency are too numerous for publication, but can be had on application at the Company's Offices.



This engraving represents one of the four "Standards," for 3,000,000 feet each, erected for the Corporation of Leeds, and now in use at the New Wortley Station;

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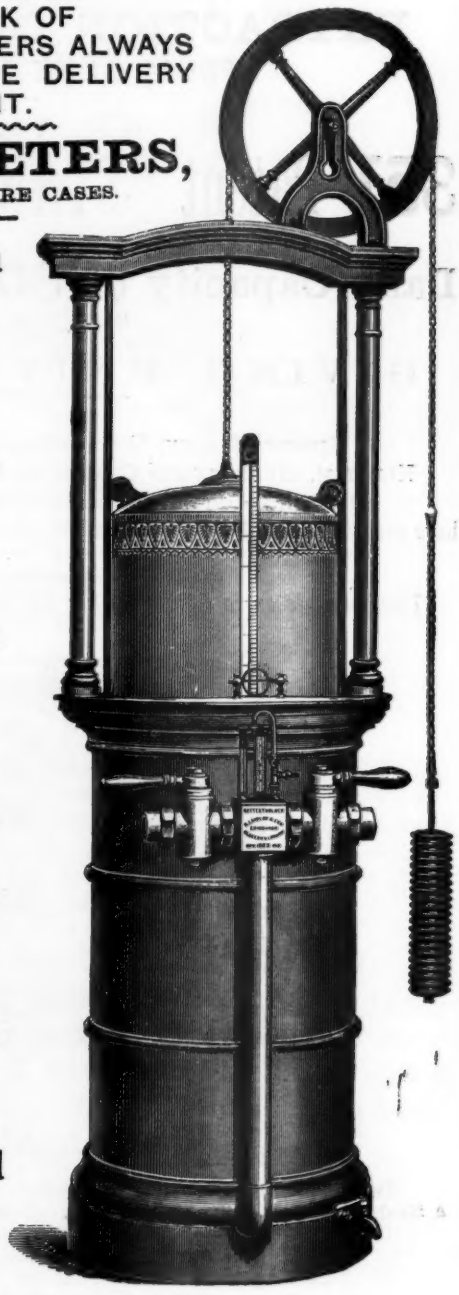

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WITH

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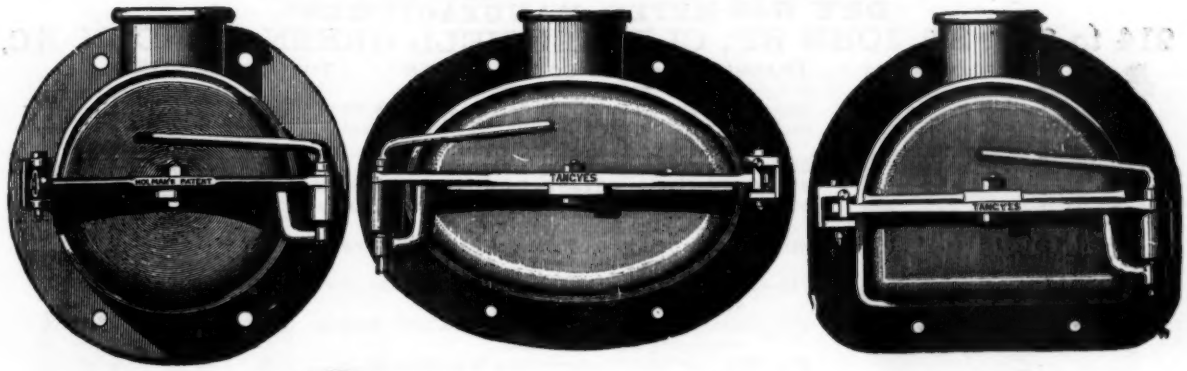

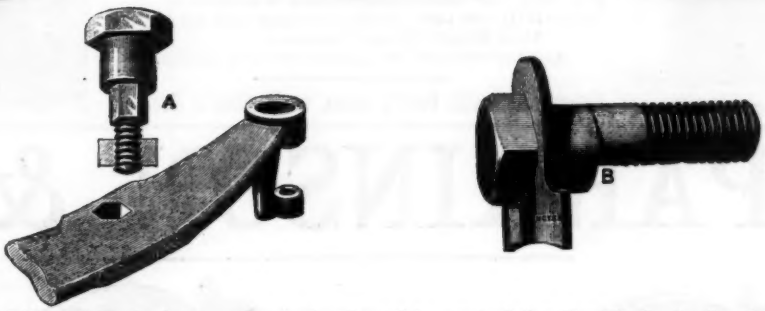

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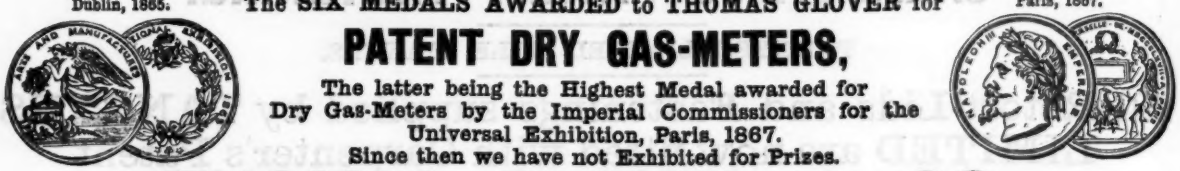

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The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.
Since then we have not Exhibited for Prizes.

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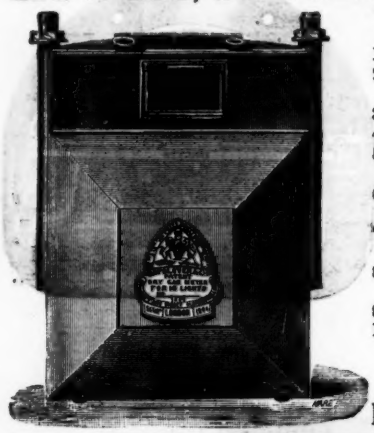

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10th—Will not cost more than one-half for repair that Wet or Water Meters do.
Are upheld for five years without charge.

Meters fitted with Grey's Index or Harding's Counter.

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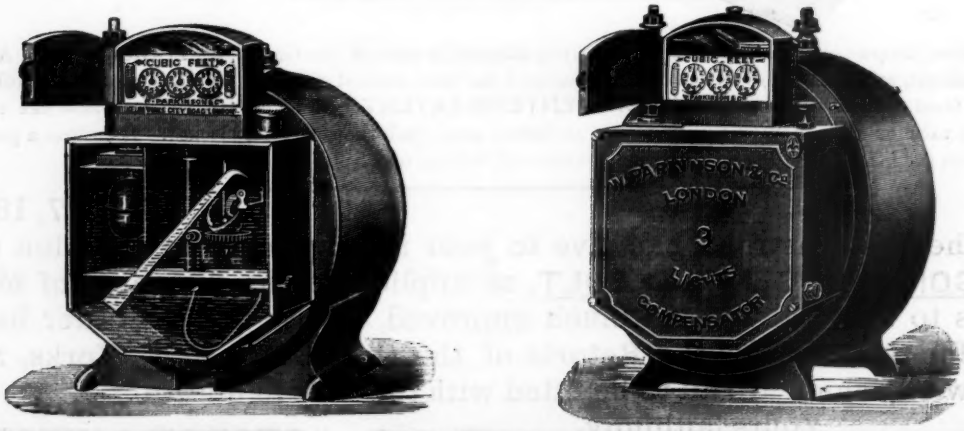

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IN TINPLATE OR CAST-IRON CASES

COMBINE THE FOLLOWING IMPORTANT IMPROVEMENTS:—

Parkinson's Patent Three-Partition Measuring Drum { *Ensures perfect accuracy of measurement with the least possible friction, works with the greatest ease, and is free from complication of any kind.*

Slow-Spoon Compensator { *Maintains an unvarying Water-line without any appreciable friction, and provides a large reserve of Water. Has stood the test of Time.*

Enclosed Float { *Allows sudden or excessive pressure on the Inlet without affecting the working of the Meter, or extinguishing the Lights.*

COTTAGE LANE WORKS, CITY ROAD, LONDON. *Telegraphic Address:* "INDEX LONDON."

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TO ADVERTISERS.

ADVERTISEMENTS for the next number of the JOURNAL must be received by Monday, 12 o'clock noon, to ensure insertion; but as the Advertisement sheet of the JOURNAL is sent to Press the first thing on Monday Morning, Advertisers will please bear in mind that Orders for Alterations in or Stoppages of PERMANENT Advertisements should be received Not Later than Two o'clock on SATURDAYS.

Telegraphic Address: "GASKING LONDON."

THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, APRIL 30, 1889.

YET MORE WATER GAS.

THE astonishing success of the British Water Gas Syndicate, whose shares were quoted last week as high as 13½ premium, is the talk of the hour among commercial men and speculators. We do not hesitate to confess that when, the day before the subscription list was opened, the rumour went about that the shares would be at 2 premium on the day of issue, we regarded the prospect as verging on the visionary. It was impossible to say that nothing of the kind could happen; but looked at with the light we possess with regard to water gas projects, we were quite justified in believing that if a little premium could be secured by the promoters of the Water Gas Syndicate, it was as much as they could expect. Very soon after the shares were allotted, however, it was perceived by a few of the knowing ones that they were going well. Day by day the premium was quoted higher. The Yorkshire Concessionary Company was successfully launched; and still the shares of the teeming parent rose, until, as the latest incident in this most astonishing story, comes the announcement of the Nottingham and Derby Water Gas Company, with a share capital of £151,000, now open for subscription. All this does not alter our opinion one jot or tittle as to the essential hollowness of the pretensions of the Water Gas Syndicate. They have no monopoly whatever in the production or utilization of water gas, which is an old thing; and there is no real foundation for the run upon the shares of the Syndicate. The dealings in these shares which have forced them up to their present snap value are gambles; and we take no more blame to ourselves for not being able to anticipate the course of the market in regard to these counters, for they are nothing more—than for inability to predict how many times head or tail may appear consecutively in the more simple form of gambling by tossing a coin. If any man could enjoy the spirit of prophecy in this kind for a few weeks, he would not long require to drive the editorial quill. Not being prophetically gifted, therefore, we have been obliged to look at this water gas "boom," as our friends across the water would term it, with the light of common experience, and, as already stated, we fail to find any justification in fact for the inflation of value which has set all the City running after water gas shares. Given the necessary conditions, and speculators would run after the shares of a company for distributing bottled moonlight. By-and-by will come the crash; and then, although a few lucky individuals will be in the happy condition of seeing their bank balances swollen by fortunate dealing in water gas stock, a greater number will bemoan their evil fate in going in just when everybody else was coming out.

A stock-jobbing success of this kind always gives rise to many stories, more or less true, of the order calculated to make poor plodders' mouths water. "I made £500 in three "days," says one, "by holding on my little allotment in spite "of people who declared the thing was only a bubble." More generally, however, the stories run on how much the narrator "might, could, would, or should have made" if it had not been for some untoward circumstance, such as selling too soon or too late. The evidence of this water gas "boom" more than ever convinces us that a Stock Market success bears hardly any relationship to the character of the business for the carrying on of which the public are asked to subscribe capital. In this case, for example, great profits are supposed to be derivable from the introduction of processes which, at least in part, two or three persons are reported to have had as their own private property for years. Mr. Alfred Wilson, whose name is mixed up with these schemes, has been designing gas-generators for years; and how is it that his processes should now be esteemed so valuable that the mere agency for them for a single county is alleged to be worth thousands of pounds? Unless we are very much mistaken, Mr. Wilson would a month or two ago have been very glad to have received an order for the erection of water gas plant, as good as anything he can make now, in any part of the kingdom for the ordinary engineer's and contractor's profit. To him comes the "financier," and behold! the whole scope of his business is changed. This may be all right, and a proper outcome of our modern system of joint-stock speculative trading. There is very much reason to urge the contrary, however, and to argue that "booms" of the kind now under notice, which arise nobody knows how or wherefore, except that they are intended to bring profit to the men who start and work them, are in the end detrimental to proper trade. The middleman is seldom of much good to anybody but himself, wherever he is found; but the financial middleman, who loads even deserving ventures with a crushing burden of capital for his own benefit, and for one new industry starts a score of undertakings intended for nothing more than gambling for premiums, is one of the worst of his objectionable order.

There will be a day of reckoning yet for the promoters of many of these water gas schemes. In the advertisement of the Nottingham and Derby Water Gas Company, no attempt is made to show the prospects of doing business in the selected area. A mere extract from the original prospectus of the parent Company is given, and the public are left to infer the existence, in the counties named, of such a field for water gas as to make it worth while to pay the parent

concern £101,000 for the right to use certain patented processes for its production. There is no pretence of any real business about the whole affair. There is generally some promise, when a localized venture of the kind is proposed, that an amount of support has been secured in advance which may be taken as proof of the existence of a demand for the services proposed to be rendered. There is nothing of the sort here, and for Nottingham and Derby the words Huntingdon and Rutland, or Astrea and Utopia, might be substituted without making any difference in the body of the prospectus. This is a convenient arrangement in view of the probability that a new Company of the same class will be put forward weekly or fortnightly until the game is played out. The type may be left standing, or at least the "copy" for the advertisements will need very little alteration. The same Directors in the main will appear, with just a sprinkling of local colour, in the shape of a brewer or ironmaster with a local address. The drafters of the model prospectus must be careful, however, or they may get into trouble when the last men left in seek relief from contributing to the Companies' assets. One paragraph in the production in question runs as follows:—

> Hitherto all attempts in this country to manufacture and apply water-gas on a commercial scale for heating, smelting, and illuminating purposes by simple and economical means, and without the use of skilled labour, have failed; but, after application and use upon a large scale, these inventions have proved beyond all doubt that pure water gas, when used as an illuminating medium in combination with the Fahnejelm magnesia comb . . . . gives a light in every way superior to coal gas, and yet having all its convenience of application, and rivalling in brilliancy the electric light, can be manufactured at under 4d. per 1000 cubic feet, after allowing for cost of production, wages, wear and tear of plant, and all contingencies."

Here is a definite statement, upon the faith of which people are asked to subscribe their money, as to the truth of which professional readers of the JOURNAL hardly need instruction. This is not all, moreover, for in the next paragraph we read that "the greater heating power of this gas, "as compared with any produced by any known means upon "a commercial scale, gives a mode of application (*sic*) to the "industries of steel manufacture, &c., and is of the greatest "possible value in its power to produce economical results "over the present systems." The slipshod diction of this passage should not blind one to the gravity of the statements. We are likely to hear again of these inducements to investors.

Lest our position in regard to these water gas schemes should be wilfully misrepresented, or misunderstood through carelessness, it may be as well to repeat here what has been said in the JOURNAL on the general subject many times, and more especially when there were no water gas speculations in the market. Water gas, as produced by any good process, of which there are a score at command, is undoubtedly calculated to be of use as a fuel, and even as a means of lighting, under special conditions. These conditions, however, require to be ascertained and defined in every case of proposed water gas utilization, and for every locality. We have even contemplated as feasible the conversion of gas coke into water gas, and the distribution, in certain circumstances, of the fuel in this form, instead of in the usual way. Where we flatly contradict the assertions of the promoters of the present water gas "boom" is in regard to their pretensions to a monopoly of success in water gas making, and further in regard to the possibility of comparing water with coal gas. Water gas is not half so powerful a fuel as coal gas; and no matter what form of cupola is employed, it takes at least 50 lbs. of good anthracite coal, or (say) half a hundredweight of the best gas coke, to produce 1000 cubic feet of it. Everybody can compute the probable cost of this, the raw material of the manufacture, for his own locality. To the cost of coal or coke for the generator must be added that for making the necessary steam; with the labour, wear and tear, and cost of capital. Mr. Dempster averages this expenditure, upon American experience, at 9d. per 1000 cubic feet; and it remains to be seen, notwithstanding all that Sir Douglas Fox has reported, how the cost is to be halved in this country. Anything that there may be besides this in the reasons for the present excitement on the subject of water gas must be looked for in the offices of stock-jobbers, and nowhere else.

TWO GAS MANAGERS' MEETINGS.

THERE were two meetings of gas managers last week, in Glasgow and Newcastle-upon-Tyne respectively. The former was what is known among Scottish gas managers as the "informal" annual meeting which perpetuates the memory of the defunct West of Scotland Association. Although the scene of the gathering is in the western part of the kingdom of Scotland, however, the territorial significance of the institution is naturally, with the lapse of time, becoming fainter. There seems, moreover, to be a little more formality about the arrangements for these meetings than the organizers at one time contemplated. A gathering at which a formally appointed Chairman pronounces a set oration, which is duly reported in our columns, and is followed by a number of speakers discussing various matters of technical interest, is, after all is said, a very close imitation of a meeting of an ordinary Gas Managers' District Association. We leave it to the parties personally interested to decide whether the admitted formality of a meeting of the latter order, or the supposed informality of the West of Scotland annual assemblies, better serves the desired object, which we take to be the promotion of good fellowship among the company. This good understanding among followers of the same calling necessarily results in the interchange of confidences and counsels upon difficult and debatable points of working experience; and so long as this undeniable good is done, it may be held to matter little whether it is brought about formally or informally. As we have already remarked, this is a matter that may be left to those concerned. If they surround their occasional meetings with all the ceremony of a technical or scientific society, we suppose it is because they like to do so. Frankly, we have on more than one occasion expressed the opinion that ceremony and form are apt to be overdone in some District Associations of Gas Managers, which have unwisely copied the machinery of large societies for their small organizations, and are decidedly overweighted thereby. It is well that everything should be done decently and in order; but when the brief time ordinarily at the disposal of the assembled gas managers of a district is half occupied by purely formal business, most of which is really superfluous, a spectator is liable to wonder why a simpler procedure is not more favoured. The chair at the Scottish meeting was occupied, in the room of Mr. W. Mackenzie, of Dunfermline (prevented by illness from attending), by Mr. J. M'Crae, of Dundee, who is always willing to help his Western friends when, as on this occasion, their resources break down. Mr. J. M'Gilchrist, of Dumbarton, is the moving spirit in these annual celebrations, and to him is due the credit for whatever good effects they produce. The gathering was certainly as successful as any of its predecessors. The meeting of the North of England Gas Managers, under the presidency of Mr. T. Bower, of West Hartlepool, was signalized by the presentment, by Mr. V. Wyatt, of another of those valuable contributions to the literature of structural gas engineering for which the accomplished author is so well known. This time the subject selected was gasholder-tanks; and as the the paper, like everything else of the kind which bears Mr. Wyatt's name, is certain to be attentively read by all practitioners and students of gas engineering, we need not discuss it here. After a short but interesting period of devotion to business, the members and their friends dined together.

THE GAS SUPPLY OF PARIS.

IN another column will be found a report on the state of the affairs of the Paris Gas Company, as presented at the annual general meeting on the 28th ult. The only new point in this statement is the alteration in the method of dividing the extra profits of the undertaking between the proprietors and the Municipality. From the present time to the end of the Company's concession in 1905, the Municipality will take an additional 600,000 frs. per annum. Public opinion in Paris, so far as concerns the question of the gas supply, is pretty well assured that the Municipality will not seriously exert itself to obtain a reduction in the price of gas so long as it takes this heavy subsidy from the Company. We have already sufficiently pointed out the evil of the concession system in gas supply when applied in the case of such an undertaking as that of Paris; and it would be useless to dwell further upon this matter. So long as some of our own "advanced" Municipalities having the control of gas undertakings "milk" the consumers for the supposed benefit of the ratepayers, it is the merest cant to blame the Paris Municipality for what they do in the same line. Notwithstanding the degree in which they are fettered by the terms of their concession, the Paris Company are doing an increasing trade. That they should have added 11,980 new consumers to their books during the past year is the best possible evidence that the Company do not experience any diminution of popularity. In face of this fact, it would be absurd to say that gas in Paris is a discredited method of lighting. The Company have displayed considerable enterprise in their arrangements for supplying consumers living in the "flats" which form such an important element in the domestic life of the French,

as they bid fair to do in the English capital. The Company also are in advance of their British compeers in the matter of supplying gas-stoves free of charge to any of their consumers who will use them. That 47,051 stoves are in use upon these terms is a striking testimony to the success of the Company's policy, which may be commended to the study of British gas manufacturers. Another matter for admiring comment is the statement in the report that several large establishments have adopted "under the advice of the Com-"pany's officers," systems whereby the heat developed by the combustion of gas has been usefully employed in ventilation. It is very satisfactory to learn that the Company have taken this important work in hand; and it can hardly fail to have the best possible effect, not only in Paris, but also wherever intelligently directed enterprise in gas-works administration is duly esteemed.

A SOLUTION OF THE PROBLEM OF GASHOLDER GUIDING.

A REMARKABLE contribution to the solution of the problem of guiding gasholders from the base, and dispensing with columns, has been made by Mr. E. L. Pease, of the firm of Messrs. Ashmore, Benson, Pease, and Co., Limited, which, when ripe for full publication, will attract great attention in the gas engineering world. We have seen Mr. Pease's system exhibited in models and drawings, and are able to say, without reserve, that for simplicity, security, lightness, and economy, it immeasurably surpasses anything yet put forward with the same object. Holders guided on Mr. Pease's principle will be safer than with the guide-columns of the ordinary method of supporting such structures; since in it the sustaining force is always acting, whereas in the old style of guiding the holder is kept from toppling over simply by its leaning against one or more of the columns in turn. The holder is always afloat, moreover—never binding or lodging for support; consequently the pressure will be unaffected by any stress of wind. No interference with the ordinary structure of the tank is entailed—the tank guides being of the usual form. The new principle may thus be applied to an existing holder without difficulty, even if only for an additional lift. A description of the system has been prepared, and was actually in type for publication in the JOURNAL to-day, but is withheld for a short time at Mr. Pease's request, in view of the completion of certain foreign patent law formalities. When it is given, however, it will be recognized as signalling the appearance of the most important improvement in gasholder construction that has come to the fore since the introduction of the telescopic holder. It is, besides, the direct outcome of the discussion of the question of guide-framing for gasholders initiated in the JOURNAL nearly two years ago.

PRIVATE BILL LEGISLATION.

THE present session of Parliament seems to bid fair to make some progress in the direction of altering the system of Private Bill Legislation. The Lord Advocate has a Bill for dealing with the Scotch side of the question, by providing for local inquiries into those exclusively Scotch projects which are now brought up to Westminster. Mr. Craig Sellar's Bill has also been introduced and printed, and now awaits consideration on its second reading. It bears the somewhat tautological title of the "Private Bill Commission "Bill," which is significant of the form into which Mr. Craig Sellar's attempts to deal with the matter have been moulded by force of circumstances. It provides for the establishment of a Commission comprising parliamentary, *ex officio*, and nominated elements. The parliamentary Commissioners are to be the Chairman of Committees of the House of Lords and the Chairman of Committee of Ways and Means in the House of Commons. The *ex officio* Commissioners are to be three in number—one for each division of the United Kingdom—who will be kept to their respective divisions. They will be Judges of Superior Courts in their countries. The other Commissioners are to be appointed by the Crown, and will be salaried. Private Bills are to be referred to the Commission instead of to Select Committees as at present; and the Commissioners are to report to Parliament. One report is to serve for both Houses of Parliament; and the full powers of both Houses for dealing with the Bills so reported on are reserved. The Commissioners will determine cases of *locus standi*, and sit in any locality that may be deemed most convenient having regard to the nature of the business before them. Sittings of the Commission for a month in the year may be held in Scotland and Ireland. The powers of the Commission are defined with regard to the hearing of petitions and the awarding of costs—in effect, the Commission is to enjoy all the powers of Select Committees of Parliament in these respects. Alterations of the Standing Orders may be made by the Commission acting with the Speakers of the two Houses of Parliament. Subject to the provisions of the Bill, the existing procedure in regard to Private Bill business is to remain unchanged. On the whole, the Bill appears to be of a moderate and practical character; and it should be beneficial in operation if it ever comes into effect. A permanent body of the kind would soon accumulate an intelligible consensus of opinion and practice with regard to the matters brought before it, which should go far to prevent for the future the hap-hazard effects often observed under the existing system. To take a recent example, it is hardly conceivable that such a tangle as the West Ham Bill could emerge from a Commission presided over by a Judge of a Superior Court. Whether other Judges would show themselves as ingenious in picking holes in the work of such a body as they are now in upsetting statutes produced by the unaided wisdom of Parliament, is a question which one scarcely likes to answer. We have always been in favour of reforming the present system of Private Bill Legislation, however, and can therefore welcome Mr. Craig Sellar's proposition. That it or any other scheme will make an appreciable difference in the cost of strongly opposed Bills, we do not believe; but it may easily make ordinary Bills cheaper. Greater consistency in legislation is perhaps the chief good that may be looked for from such a reform.

MISS A. KELMAN has been engaged to give a special course of lectures on "Food in Relation to Health," at the Universal Cookery and Food Exhibition, to be held during this week at the Duke of Wellington's Riding-School, Knightsbridge.

MESSRS. DORMAN, LONG, AND CO., steel and iron manufacturers, of Middlesborough, have taken offices at No. 19, Victoria Street, Westminster, where in future their London business will be conducted by Mr. H. B. Powell.

THE last number of the *Journal des Usines à Gaz* contains the preliminary programme for the forthcoming congress of the Société Technique, which will be held in Paris from the 11th to the 14th of June next. The arrangement of the business will be practically the same as on previous occasions; the last two days being devoted to visits to works and conferences at the exhibition.

THE Directors of the Swindon New Gas Company propose to institute a monthly system of meter reading and rendering of accounts, in place of the present quarterly system. They consider that the accounts will thus not only be more regular and uniform, but the Directors hope that under the new arrangement they will be able to give more attention to consumers in matters relating to the satisfactory and economical use of gas.

LAST Tuesday, the marriage of Miss Gertrude Lever, third daughter of Mr. Ellis Lever, with Mr. Alfred W. Mason, of Bowdon, Cheshire, was solemnized at Llandrillo Church, Colwyn Bay, in the presence of a large number of relatives and friends. The event was the cause of much excitement in this usually very quiet little Denbighshire watering place; and it was celebrated by a grand ball given by Mr. and Miss Lever on the following evening to the guests and friends at Tan-y-Bryn, Mr. Lever's residence. The presents were numerous and costly.

AT the recent annual meeting of the Paris Gas Company, a vacancy on the Board caused by the death of M. Pernolet, who had been a Director for a period of 18 years, was filled by the appointment of M. Camus, the General Manager. The works of the Company, at La Villette, were lately visited by the President of the Republic (M. Carnot), who signalized the event by decorating M. Lemaire, one of the Company's Engineers, and formerly a student at the Polytechnic School, and by distributing ten medals of honour among workmen who had been in the Company's service more than 40 years. He also left a donation of 500 frs. for the workmen's provident fund.

ACCORDING to the *Electrical Review*, the report of the Metz Gas Company states that there has been a diminution of receipts and of profit, owing partly to the Municipality having introduced economies, and partly to the use of the electric light at the railway station. The consumption of gas by the public has, however, increased. At the general meeting of the Company, the Directors were empowered to establish a small central electric light station for such of their customers as might wish to adopt the new light. At Malaga, the report of the Gas Company states that the experiments undertaken are approaching a termination; and it is considered advisable to establish a small electric light station. The shareholders have instructed the Directors to act as they think best for the interests of the Company. The Directors of the Montauban Gas Company have been authorized to establish a central electric light station. At Angers, the consideration of the matter has been postponed until the exhibits at the Paris Exhibition have been examined, with a view to finding out the best system of electric lighting. A credit has been voted by the shareholders of the Florence Gas Company for the establishment of an electric light station.

Essays, Commentaries, and Reviews.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 824.)

Holidays have again interfered with business on the Stock Exchange during the past week. But although limited in extent, transactions have shown considerable variation. The tendency at first was downward; but a decided recovery set in on Thursday, which was aided to some extent by the easiness of the Money Market. There was another change, however, just before the close of the week; and the last prices show some depression. The Gas Market has been firm on the whole; but witht he notable exception of Gaslight "A," which is rather weaker. The opening price, 262½, was the best of the week; and the closing price, 260½, was the worst. There was some demand for the debenture, preference, and maximum issues; with the result that the "G" has risen 2, and the "H" has commanded rather better prices, although the quotation remains unchanged. South Metropolitans have been much more active than of late; and all three stocks have advanced in value. A single transaction in the old stock was all the business recorded in Commercial; but the quotation is 1 higher. Nothing at all has been done in any of the Suburban or Provincial undertakings; and their quotations remain unchanged. Among the Foreign division, Imperial Continental has made the advance which we last week credited it as being worth, and has changed hands two or three times at 219. Buenos Ayres has improved ½. Moderate business has been done in a few other companies; but nothing to call for special remark. San Paulo is quoted *ex div.* The Bombay Company will meet to-morrow week, and will declare their usual 7½ per cent. dividend. The Water Companies have been extremely quiet; and few transactions have been marked. Prices generally are only moderate; and East London is quoted 1 lower. On the other hand, Southwark ordinary has advanced 1.

The daily operations were: A very fair amount of business was done in Gas on Tuesday, when the market re-opened after the Easter vacation—mostly in the issues of the Metropolitan Companies. In Water, the only record was a single transaction in Chelsea. Wednesday's Gas business was largely in the secured ssues of Gaslight and Coke. Prices generally were good; and there were several improvements made in quotations. Gaslight "G" rose 2. In South Metropolitans, the "A" advanced 2; "B," 2; and "C," 5. Imperial Continental improved 1; and Buenos Ayres, ½. Water was very quiet and dull. East London receded 1. Business in Gas was much more restricted on Thursday; but prices were very fair, especially for Imperial Continental. Commercial old rose 1; but Gaslight "A" receded to a similar extent. Water was quiet and unchanged. There was a shade more activity in Gas on Friday; and prices were about the same. Water offered nothing for remark. Saturday was about as quiet as usual. Transactions were mostly in Gaslight "A;" and the prices were rather easier. Nothing was done in Water, except in Southwark and Vauxhall, the ordinary shares of which rose 1.

ELECTRIC LIGHTING MEMORANDA.

THE BOARD OF TRADE INQUIRY—THE AFFAIRS OF THE BRIGHTON ELECTRIC LIGHT COMPANY—A PROPOSED ELECTRIC LIGHTING SPECULATION FOR PLYMOUTH—THE COMMISSIONERS OF SEWERS AND THE ELECTRIC LIGHT—GAS-MAINS AND ELECTRICAL CONDUITS IN NEW YORK.

The Board of Trade inquiry by Major Marindin has been continued since the brief Easter holiday, and may be regarded as having entered upon its concluding phase, a number of the witnesses examined last week having been the smaller fry of vestrymen and surveyors. Professor Crookes, F.R.S., was the first witness called on the resumption of the sittings, and told how he had founded the Notting Hill Electric Lighting Company for the purpose of providing electric lighting for a number of wealthy residents in the neighbourhood named, who were willing to pay handsomely for the luxury. This little Company had satisfied the Vestry of their *bona fides*, and naturally objected to be ridden over roughshod by the big Corporations hailing from Deptford and Whitehall. The same position was taken up by the Kensington and Knightsbridge Company, which is a child of Mr. R. E. Crompton. They, being in Kensington, very much objected to any other Company coming into the same neighbourhood. Several other small district Companies opposed the great speculations already alluded to, and not a few Vestry Clerks came forward to declare the unwillingness of various parish authorities to admit any electricians whatever within their boundaries. Some of these, like Paddington, want to supply electric lighting themselves if it is done at all; but meanwhile confess that there is no great demand for this method of lighting. Others object strongly to the granting of what would practically be a roving commission to any electrical company, permitting experiments in public and private lighting for the benefit of speculators who would not have the public interest at heart. The Paddington Vestry have taken such an interest in the matter of electric lighting on their own account that they have consulted Professor Forbes on the subject; and have been advised that they could possibly provide themselves with arc lamps for street lighting at about £20 per lamp per annum, and supply incandescent lighting at a charge of 4½d. per Board of Trade unit for current. This would be equivalent to gas at about 4s. 6d. per 1000 cubic feet. We all know, however, what electricians' estimates of cost are worth. On the whole, so far as the inquiry has gone, the position of the great Companies has not improved. Many of the assumptions upon which they sought to force their way to acceptance, treating their own projects as accomplished facts, have been exposed by different opponents. Mr. H. L. Cripps, who appears for the Strand District Board of Works, has done a good deal in this way.

There has been a Board of Trade inquiry at Brighton, too, also held by Major Marindin (perhaps as a kind of holiday interlude to his heavy work in Westminster), upon an application for a Provisional Order by the Brighton Electric Lighting Company. Mr. Shiress Will, Q.C., appeared for the petitioners, and engaged on their behalf that if they obtained their Order they would consent to the imposition after seven years of a standard price and a sliding scale on the gas companies' model. Mr. Robert Hammond, the Chairman of the Company, was examined in support of the Order, and had a "bad quarter of an hour" under cross-examination—having to reveal some of the history of his failures in the electric lighting propaganda to which he has been so devoted for some years past. The Order is strongly opposed by the Corporation of Brighton, and, indeed, by everybody outside the Company. It was pointed out that, although the Company had been started under exceptionally favourable circumstances—obtaining their premises, plant, and works at an enormous discount on the original cost, and enjoying the advantage of a remarkably good district—they were only able to show a dividend of 5 per cent. for the third year, working with overhead wires. Even this profit was derived from wiring new premises, which could not be expected to continue; and an insufficient allowance had been made for depreciation. Counsel for the Corporation contended that the Company were unable to pay their way with overhead wires, and could not possibly expect to earn a dividend after incurring the expense of putting their wires underground. It does not look very probable, on the evidence, that the Company will get their Order.

After reading the account of the proceedings at Brighton before Major Marindin, it is decidedly entertaining to observe in a Plymouth newspaper an ingenious argument in favour of a scheme for the introduction of electric lighting into the Three Towns, which is to "utilize the experience and knowledge gained at Brighton, Eastbourne, and Kensington." So Mr. Robert Hammond has gone as far as Plymouth, fondly imagining that the truth respecting his performances at Brighton and Eastbourne will never travel such a distance westward! The scheme, we are told, has been laid before the Corporation of Plymouth; and the naval and military authorities of the town and district are asked for their patronage. If Mr. Hammond means nothing more than to act straightforwardly towards these prospective clients of his, he will not object to their applying for and receiving from the Corporation of Brighton a full note of the proceedings at the Board of Trade inquiry in this town, wherein the standing of the local Electric Lighting Company was clearly described. After perusing the report, the Plymouth Corporation will be in a better condition than they now appear to be for determining the prospects of electric lighting, Plymouth gas is among the cheapest in the Kingdom; and how Mr. Hammond, who cannot make a profit in Brighton or Eastbourne, is to do so in Plymouth, we altogether fail to understand.

Electricians are hard to please. The two great prizes in the electric lighting business now open to them are the lighting, respectively, of Paris and the City of London. The terms of the concessions for the Paris electric light districts have been settled very clearly and precisely by an authoritative Commission; and consequently the electricians protest that they are so tied that they cannot touch the job. In the City of London, on the other hand, only the most general requirements for the electric lighting have been laid down; and now the *Electrical Review* complains that a specification ought to have been drawn up "complete in all its details, and upon which contractors could directly base their estimates." Really, it is difficult to know what will please. The City Commissioners of Sewers leave all technical matters to intending tenderers, stating only what they want, and giving contractors full liberty to say how they mean to do the work. Full particulars on this head are demanded, of course, in order that the Commission and their advisers may judge for themselves how the requirements of the public are likely to be met. Beyond this everything is left open. There is no attempt to bind contractors to any particular system of generation, storeage, or distribution. If anybody thinks he has a better device for the purpose than has yet been tried, he is at liberty to make good his claim to the profits derivable from the supply of electric light to the richest commercial community in the world. Somehow electricians are slow to take advantage of the offer—Why?

The Board of Electrical Control of the City of New York have recently held a special sitting to consider the subject of the explosion of gases in the subway conduits that have been constructed for the accommodation of electric light wires. Many instances of this class of accidents have occurred of late, causing much disturbance of the public mind, and doing some damage to property. Fortunately, there does not appear to have been any loss of life as yet through these explosions; but such a result may happen at any time. The electrical supply companies complain that gas from leaky gas-mains filters through the subsoil and fills the cable conduits with an explosive mixture which takes fire from the lamps used to make soldered connections, &c. It is admitted that the prevalence of competition in gas supply in New York led to the laying of an unnecessary number of gas-mains in the streets, many of which were carelessly jointed. The difficulty is to find a remedy. The gas-mains were in the streets first, and did no damage

until the electrical conduits provided a receptacle for an explosive mixture; on the other hand, it is claimed that the gas companies had no right to do their work in such a way as to prevent the use of the streets for another purpose. Ventilation of the conduits would cure the mischief: but they are so small in area that it is practically impossible to get a free current of air through them by natural means. The facts of the case were thoroughly gone into by electrical and gas engineers before the Board; and a Committee has been nominated to draft a report on the result of the inquiry. When this report has been presented, the Board will determine upon the steps to be taken.

Notes.

The Radiometer as a Photometer.

Mr. W. Hillier has written to *Industries* drawing attention to the exhibit of Mr. Crookes's radiometers at the South Kensington Museum. He declares these instruments to be of great value for testing the comparative intensities of different sources of light, and hazards the statement that they "enable results to be achieved which, for absolute accuracy, would hardly be attainable by any other known means." The following figures give the results of some experimental observations made with a view to testing the action of the radiometer under the influence of light passing through glasses of different colours, the source of the light being a standard candle at a distance of 5 inches behind the glass:—

Green glass	caused	one	revolution	in	40 seconds.
Blue	"	"	"	38	"
Purple	"	"	"	28	"
Orange	"	"	"	26	"
Yellow	"	"	"	21	"
Light red	"	"	"	20	"

The mechanical action of the radiometer produced by radiation is inversely proportional to the square of the distance. Thus, an instrument exposed to the light of a candle at a distance of 20 inches gave one revolution in 182 seconds; with the same candle placed at a distance of 10 inches, the result was one revolution in 45 seconds; and at 5 inches distance, there was a revolution in 11 seconds. The influence of heat may be partially cut off by the interposition of a screen composed of a thick plate of alum, when the radiometer practically becomes a photometer. Mr. Hillier quotes from a paper contributed by Mr. Crookes to the Royal Society in 1876; and suggests that now numerous systems of electric lighting and improvements in gas lighting demand such careful attention, the radiometer might be taken more notice of. It is admitted that probably the greatest obstacle in connection with the practical application of the radiometer to photometric purposes is the difficulty of recording the number of revolutions accurately and automatically. Mr. Hillier does not seem to know that the inventor of this instrument has abandoned the hypothesis which he at first framed to account for its action—that the revolution of the radiometer vanes is due to the direct mechanical action of light.

Patent Fuel in Oval Briquettes.

The trade in oval-shaped lumps of patent fuel for domestic uses is rapidly growing, especially in Belgium. The method of manufacture has been explained by M. Legrand to the Association of Old Students of the Mons Mining School. The idea of making the blocks of fuel in this form was taken from the natural example of moulding a block of paste between the hands. The raw materials were at first coal dust and tar, with which there were many failures; but the agglutinant is now dry pitch, which succeeds perfectly. The machine for making the oval lumps is the design of M. Fouquemberg, and consists essentially of two revolving cylinders, each forming half the mould, driven by an endless screw. The materials are powdered and mixed in a hot agglomerator, whence they reach the moulding machine in the form of paste; the machine being cooled by a circulating current of water. The slightly flattened oval form is found most successful in practice, as the lumps have only a few points of contact in the fire, and consequently burn freely even when composed of the worst kinds of coal dust. The ovoid form has many other advantages. It lends itself to automatic stoking, is not liable to break in transport, nor cause dust; its small size adapts the fuel to any kind of furnace without further preparation; and for these reasons it is becoming very popular for domestic fires. This trade, which is based upon such an apparently trifling matter as the form of the lumps, is in fact another illustration of the necessity for studying the details of household requirements which has led to the mechanical breaking of gas coke into sizes suitable for small stoves and kitcheners.

The Poisonous Quality of Respired Air.

MM. Brown-Séquard and D'Arsonval have made a further statement to the Académie des Sciences respecting their discovery of a poisonous principle in water condensed from respired air. New researches, made at the beginning of last year, have shown that this poison, be it simple or multiple, which accompanies expired air, is able in small quantities to kill even without being directly injected into the blood. This toxicity is not due to the presence of microbes in the pulmonary liquid, for the same effects are produced by it after having being subjected to a temperature of 100° C. in a closed vessel. During the past year, many experiments have been made to determine the action of the pulmonary poison as it exists in respired air mixed with pure air, the results of which have completely confirmed what has been learnt respecting this poison by other methods. An apparatus has been used for this purpose which, while showing the poisonous property of respired air, has also permitted it to be demonstrated that the carbonic acid of this air has nothing to do with its toxicity. The apparatus consists of a series of metallic boxes connected with each other, but shut off from the outer air by sealed joints. An aspirator connected with a gas-meter draws a measured current of air through the series of boxes, one after another. It consequently follows that an animal shut up in the first box breathes pure air, while others enclosed in successive boxes must breathe air more and more vitiated. Every care is taken to provide for the drainage of the boxes. It was found that animals shut up in these boxes died sooner or later according to their distance from the fresh air box, although the proportion of carbonic acid never became more than 2 or 3 per cent. of the air which proved most deadly. Pure carbonic acid in the proportion of 20 per cent. of the air was breathed by the same animals with impunity. Also when the pulmonary poison was arrested by passing the air containing it through a washing chamber charged with concentrated sulphuric acid, which would not have any effect upon its carbonic acid, the toxic quality disappeared. Hence it may be deduced that the atmosphere of all badly-ventilated rooms occupied by men or warm-blooded animals, is charged with an unknown active poison which would kill all the inmates if they remained long enough under its influence, and even in a short time affects their health.

Railway Carriage Lighting by Gas.—Trial attempts having been successfully made in lighting carriages on the Newcastle and Tynemouth branch of the North-Eastern Railway with Pintsch's gas, this method will be introduced speedily on the main-line and on most of the branches.

Sulphate Plant for the Tottenham Gas-Works.—We learn that the Tottenham and Edmonton Gas Company have placed an order for a complete 30-ton sulphate plant with Mr. H. Simon, C.E., of Manchester. It will be constructed on the continuous principle, and be capable of dealing with about 7000 gallons of ammoniacal liquor per diem.

Gas Enterprise in Japan.—We learn from a letter just received from Mr. W. Newbigging (Manager of the Tokio Gas Company) that an exhibition of gas-lamps and other apparatus used in the consumption of gas was held in Tokio, the capital of Japan, at the beginning of last month. This was a source of great attraction, and was most successful; being attended not only by the general public, but by upwards of 150 Government officials, members of the Chamber of Commerce, and the leading merchants. The result has been the despatch of orders to England for a considerable number of Wenham, Bower, Siemens, Thomas, and other lamps.

The Halifax Gas Scandal.—At the meeting of the Halifax Town Council to-morrow (Wednesday), Alderman M. Booth is to move to rescind two resolutions adopted by the Council on Oct. 3—one relating to the withdrawal from the Committees of the Council of any member named in charges then read until such charges had been investigated; and the other calling upon Alderman Riley to commence a civil action against Mr. T. K. Fox for the purpose of having the charges made against him fully investigated, and granting him an indemnity if the verdict were in his favour. In lieu of these, Alderman Booth will move that Alderman Riley be appointed a member of the Water-Works and Baths Committee and the Watch and Bonding Warehouse Committee.

Issue of Debenture Stock by the Gas, Water, and General Investment Trust, Limited.—By an advertisement which appears in another part of the Journal, our readers will see that the above-named Trust are about to issue £250,000 of 4 per cent. perpetual registered debenture stock at the rate of 101 per cent. The formation of this Trust was noticed in the Journal for Jan. 22 last; and it may be remembered that the power to issue debenture stock equal in amount to the subscribed capital was conferred on the Directors by the Articles of Association. The total amount of stock authorized is £500,000; so that the Directors are now exercising only half their powers in this respect. When it is borne in mind that first-class English railway debenture and preference stocks, English Corporation bonds, and the best Colonial inscribed stock, return the investor only from 3 to 3½ per cent., the stock offered by this Trust bears favourable comparison with these securities.

Western (U.S.A.) Gas Association.—The twelfth annual meeting of this Association is to be held at Cincinnati on the 15th, 16th, and 17th prox. The official notification of the arrangements, which has been issued by the Secretary (Mr. A. W. Littleton), states that five papers have been promised for the occasion, in addition to which there will be a lecture by Professor Mendenhall on the "Nature of Light." With regard to the papers, Mr. G. T. Thompson will deal generally with retort-house work; Mr. K. M. Mitchell taking up the subject of retort-furnaces for burning coal; and Mr. R. D. Walsh, that of inclined retorts. Mr. C. R. Faben, jun., will discourse upon fuel gas; and Mr. J. M'Ilhenny upon incandescent gas lighting. The subject of the use of crude oil for firing retort-furnaces and enriching coal gas, will be brought before the members by Mr. J. H. Woodmansee; and Mr. G. A. Hyde, jun., will give his views on the question of accounting for meters, so as to see that none are lost. The foregoing are all matters which should give rise to interesting debates; and there is consequently good prospect of the meeting being a useful and instructive one.

Communicated Article.

PHOTOMETRY AND ITS SUBSTITUTES.

By John T. Sheard, F.C.S.

The recently-issued Instructions of the Metropolitan Gas Referees have doubtless been perused with much attention by all who take a practical interest in photometry. While it will readily be conceded that both in fulness and definiteness of direction the memorandum is an advance upon that which it supersedes, it must—to those who are acquainted with what has already been done to further the art—be extremely disappointing. If, in the face of all that has been proved to its discredit, the old photometrical standard is to be retained, it was at least to be expected that the instructions would be based upon the soundest principles, and embody the most reliable means of carrying out the protometrical operation. It has hitherto been too much the rule to look upon the procedure enjoined by the Gas Referees as the highest limit attainable—or at least to be aimed at—in matters photometrical; but the opportunity ought now, I think, to be taken to protest against the methods prescribed in the latest Instructions being considered as representing the high-water mark of progress in such matters, or as reflecting the most advanced and truest views thereon. In the interest of the gas industry, objection must be taken to both the directions for consuming gas, and the treatment prescribed for the burning candles. As to the former—which, in its possible influence upon the results obtainable, is the most important of the regulations—it may be, and probably is, the case that the rate at which the gas shall be burnt has been determined by the Legislature, and is not within the control of the Gas Referees. This, however, simply shifts the responsibility for an injustice; but does not lighten it. For to fix a hard-and-fast line as to the amount of gas which shall in every case be consumed in photometrical examination is, I contend, a grave injustice, and ignores altogether the true principles upon which varying samples of gas should be consumed to obtain strictly comparative values. It is an injustice to the gas, which it is calculated to undervalue; and to the gas maker, who does not obtain credit for the full value of the article he supplies, or, on the other hand, is restricted in his operations by the necessity of his gas (when tested in the standard burner), having to comply with an arbitrary and unscientific condition. The object of photometrical gas testing is to ascertain the potentiality, as regards illumination, of coal gas compared with some other source of light; and the purpose of a standard burner is to enable samples of gas, in varying circumstances of time and place, to be compared strictly with each other. What it is required to know is not simply how much light is afforded by the combustion in each case of so much gas, or how much light will the gas develop in one particular form of burner; but what is the ultimate value, for the purpose of illumination, of one gas as compared with another. Rightly considered, the true purpose of a standard burner is to allow different samples of gas to be consumed under similar conditions of combustion (not necessarily, be it noted, of *consumption*)—that is, to afford equal facilities to each gas to develop the maximum illuminating power it is capable of yielding in the particular burner employed. The theory (whether or not it is borne out by the facts does not at present concern us) is that what is true for one burner in such circumstances, is relatively true for all; that, in short, a true comparison of the potentiality, as regards illumination, of each gas is thereby obtained.

Coal gas is not a simple substance of definite and unvarying composition; but a compound whose component elements exist in different amounts and proportions according as the material from which it is produced, and the processes of its manufacture are unlike. And with the many modifications and new methods that are being introduced into its manufacture (Dinsmore processes and air and oxygen purification, for example), it is likely in the future to differ more and more. To the photometrist, however, its composition is a matter of indifference—what he has to do with being the amount of light which it is capable of affording on combustion. This being so, the conditions under which it is tested should be such that differences of composition may not affect the result of the test. Now it is a fact that, owing to differences of composition, a greater quantity of one gas can be properly consumed in the standard burner than of another, although the actual illuminating value when tested under equal conditions, may be the same. In other words, while 5 cubic feet of one gas may give a flame reaching to nearly the top of the chimney—thus being most effectively consumed—the same quantity of another gas may be incompletely burnt, and give off smoke; while of yet another, the flame may be so short, compared to the length of chimney, that the gas is overburnt. Tested under those conditions, injustice would be done to the two latter; both which would have assigned them a lower illuminating value per cubic foot of gas than if tested with a consumption sufficient to produce a similar height of flame to the first named. It is thus quite possible for a gas, tested under the conditions prescribed by the Gas Referees, to be condemned as deficient in illuminating power when an alteration in the quantity of gas consumed would have enabled it successfully to pass the ordeal. The only fair and correct rule then to be observed, as regards consumption of gas, is, I contend, to burn in every case that quantity of gas which can be most effectively consumed, which, in practice, will be sufficient to give the largest flame attainable in the chimney without smoking.

As regards the candles, there are two matters on which the treatment prescribed is not, I think, the best that might be devised. First, it is directed that "before each testing, the two candles are to be so placed that the plane of the curvature of one wick shall be perpendicular to the plane of the curvature of the other wick." Now, it seems to me a more rational method to place the candles so that the curvatures of both wicks are in the same plane with the wicks inclined to each other; and this for two reasons: First, the candle flames are thereby brought closer together, and to an imaginary line parallel to the bar, and passing through the centre of the disc and of the gas-flame; second, the disturbing effect of the deflection of the wick—and with it the flame—to the right hand or to the left, which takes place as the candle burns, is neutralized by the two wicks turning in opposite directions. Thus, as one candle flame approaches the disc, the other recedes from it in corresponding degree. (A striking illustration of this deflection of the candle-flame is given in a series of engravings from photographs contributed in a letter to the Journal, a few years ago, by Mr. Sugg.*)

The other item in the treatment prescribed, to which I take exception, is that limits are imposed as to the consumption of sperm which is to be allowed, but none as to the amount of variation which is to be permitted in the readings obtained in the course of an experiment. True it is now stated that "if the Gas Examiner should observe, during the testing, that the candles are burning irregularly, . . . the testing is to be rejected; and a fresh testing made. But what is meant by this precept is not sufficiently clear and explicit; and I think it very necessary that some such regulation as the following should be added:—"A testing is to be discarded when the value assigned to the gas in any one observation shall differ from any other by an amount equal to (say) 5 per cent. upon the highest value obtained in the ten observations." With such a rule, the limits of consumption of sperm now prescribed might be widened; and yet obtain more concordant results than are otherwise possible. As an illustration of my meaning, I append the following extract from my note-book:—A gas was tested with the following results:—Illuminating power, 21·68 candles; consumption of sperm, 116·4 grains; readings varied from 9·4 to 10·6. A second experiment, immediately following, with another pair of candles—all other conditions being the same—gave illuminating power 19·88 candles; consumption of sperm, 111·6 grains; readings varied from 9·3 to 9·6. The first experiment would have been accepted, under the Instructions of the Gas Referees, and the second rejected; but I have no doubt whatever the latter represented the actual illuminating value of the gas tested.

It cannot, however (until an alteration is made in the legal standard of light), be too often reiterated that, with the most careful treatment that can be devised, the candle is an unreliable standard. In witness whereof I may be permitted to cite the following experiments, all carried out on the lines I have indicated in this article, and in no detail of them overstepping the limits laid down.

Comparison of the Illuminating Power of Gas as determined by means of two Pairs of Candles marked A *and* B.

Source of Gas Tested.	Consumption of Gas per Hour.		Consumption of Sperm per Hour.		Illuminating Power.		
Holders.	A. Cub. Ft.	B. Cub. Ft.	A. Grams.	B. Grams.	A. Candles.	B. Candles.	Dif'rence Candles.
No. 1 . .	4·57	4·54	121·8	122·1	18·93	20·58	1·65
No. 2 . .	4·56	4·56	120·0	121·8	19·34	21·16	1·82
No. 3 . .	4·70	4·70	121·8	122·4	19·22	20·34	1·12
Averages .	4·61	4·60	121·2	122·1	19·16	20·69	1·53

Greatest difference between individual readings in any experiment, 8·6—9·0 candles.

A few words in conclusion as to the suggested substitutes for the present system of photometry in the valuation of gas. The specific gravity test will not, I venture to say, be found of much value. I have not found in my own experiments, nor observed in the records of others', any sufficiently close accordance between the specific gravity of different qualities of gas and their illuminating power. Indeed, looking at the varying composition of coal gas, and considering what is known of its several components, it would be matter for surprise were it otherwise. In any practical process of estimating the value of gas from its specific gravity, carbonic acid would, of course, require first to be eliminated and its amount allowed for; but what about nitrogen? which cannot be eliminated, and, where the air process of purification is in operation, may be present in more than the usual amount, giving a high specific gravity. Further, of the diluent gases, carbonic oxide exerts a much more injurious effect upon the illuminating power than does marsh gas, while it is nearly twice as heavy. From all which it is to be inferred that the specific gravity test cannot, in the present state of our knowledge of the subject, afford any useful indication of the illuminating value of so complex a substance as coal gas.

A more hopeful direction in which to look for a solution of the problem may be found in the estimation of the absorbable hydrocarbons. Simply to determine their percentage amount by volume, as is usually done, is of little or no utility; but it is not impossible to absorb and weigh them, which would be much more serviceable. Yet even were this done, it is far from certain that

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the illuminating value of the gas could be accurately deduced therefrom. Much requires to be done in the way of experiment before this can be accomplished; but it is in the direction of absorbing and weighing the heavy hydrocarbons, and, to some extent, of discriminating between them, that we must look for the most serviceable process of estimating the value of coal gas otherwise than by its combustion.

Is anything known as to how the "thermophote" has fulfilled its promise as a valuer of illuminating power? This was an apparatus invented by Dr. T. O'Connor Sloane, of New York,* for the purpose of estimating and automatically recording the intensity of the radiant heat of a gas-flame; it being assumed that the illuminating power varied as the temperature. Apart from the question of whether the assumption that radiant heat and light are identical is justifiable, there seems to me to be this drawback to the successful working of the instrument. No notice is taken of size of flame; but, in order to admit of an automatic record, one fixed consumption of gas is maintained. Now, a gas-flame resulting from the consumption of the same quantity of different gases may vary in size as well as intensity; and what is required to determine the illuminating power is a measure of both. Something like a combination of the illuminating power meter and the thermophote seems, therefore, to be indicated as the most promising mechanical method of determining the illuminating power of gas.

Technical Record.

NORTH OF ENGLAND GAS MANAGERS' ASSOCIATION.

The North of England Gas Managers' Association held their half-yearly meeting, in the offices of the Newcastle and Gateshead Gas Company, on Saturday last. Mr. T. Bower, of West Hartlepool, the President, occupied the chair.

An Obituary Notice.

The President, before proceeding with the business of the meeting, referred to the lamented death of the late Mr. Allan, of Stockton-on-Tees, one of the Associates. They would, he said, all agree with him that he not only was a prominent associate, but he was a gentleman who, in his time, they were always glad to see. His was a kindly disposition; and he took a deep interest in the welfare of the Association. He (the President) had no doubt all would join with him in expressing their regret and sympathy with Mr. Allan's family in their bereavement.

New Members.

The following were admitted to the Association:—Mr. John Bruce, Gas-Works, Shotley Bridge, as a member; Mr. J. Coates, of the Rosemount Iron-Works, Elland, as an associate.

Representation on the Council of The Gas Institute.

The President thought it might be of service if he just mentioned that, as they were all aware, the late split in The Gas Institute had greatly reduced the members of Council, and there was a considerable number of vacancies on the Council to be made up at the next election. It had been said—whether rightly or wrongly, he did not know—that the North of England Association had been rather negligent in the voting, and in seeing that members from their own locality were first nominated and afterwards elected as members of the Council. He might say they had this matter before their Committee a week or two ago; and it was decided that two members from the North of England Association should be nominated as members of the Council of the Institute. He had no doubt that the members of the Association would, as far as their influence went, see that these nominations were supported. In speaking in this strain, he might be said to be speaking rather from a personal point of view, inasmuch as he happened to be one of the members nominated. But he believed the general opinion of the Committee was that it would be desirable, not only on this occasion, but on future occasions, if some rule on the subject could be adopted. It would be a benefit to their own body, and perhaps to the parent Institute as well, if the President of the Association, and also the President for the time of all other District Associations should, during his term of office, be brought into touch with the Council of The Gas Institute. By doing this, it would be an advantage to the District Associations, as thereby they would have direct representation on the Council of the Institute. Personally, he thought it would be a very great advantage; and now the members were wanted he had no doubt that, as far as possible, they would see that their influence was used in securing what members they could for the North of England Association. He believed that one or two, perhaps, of the other Associations had the same views on this matter, and would use what influence they could to get, not an undue representation, but an equal representation throughout the country, on the Council of the Institute.

Valedictory Thanks of the President.

The President went on to say that, as this was the last time he should occupy the chair, he would congratulate the Association, and the gas industry generally, upon the continued prosperity of their business. Notwithstanding the competitors they had now to contend with, he thought they would all agree with him that the gas industry generally was never in a more flourishing condition. He had no doubt that all that could possibly be done by gas managers would be done to still further promote the interests of the companies they represented, and the gas industry generally. With these few remarks, he thanked the members for the support they had given him during his year of office, and especially for their attendance and the trouble they took in going to West Hartlepool last autumn.

New Officers.

The Scrutineers subsequently reported that the following officers for the ensuing year had been elected:—

President.—Mr. R. Bridge, of Doncaster.
Vice-President.—Mr. Wm. Hardie, jun., of Tynemouth.
Auditor.—Mr. J. H. Penney, of South Shields.
Secretary.—Mr. Wm. Hardie, of Newcastle.
Committee.—Messrs. William Ford, of Stockton-on-Tees; T. Bower, of West Hartlepool; J. Hepworth, of Carlisle; and J. H. Cox, sen., of Sunderland.

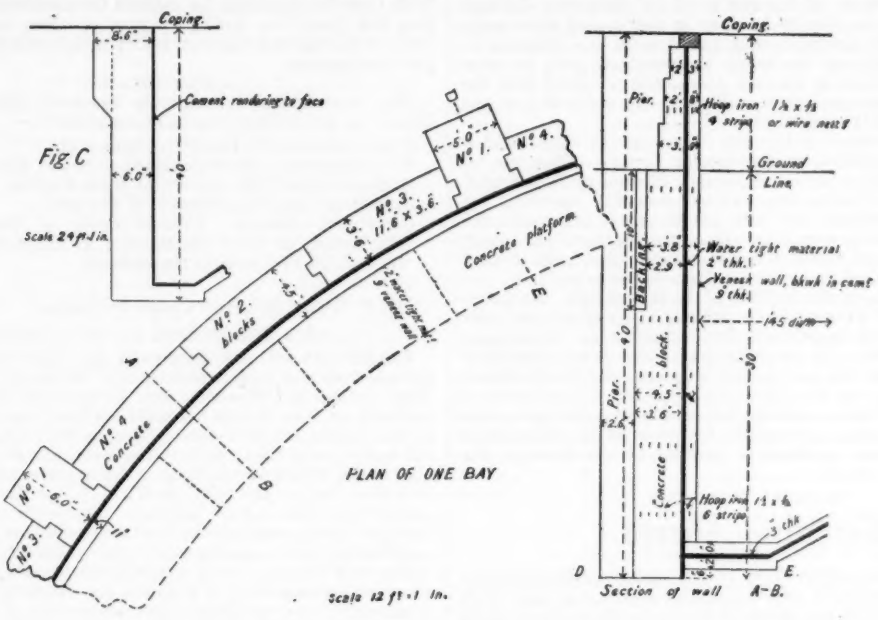
Mr. V. Wyatt then read a paper entitled—

A NEW DEPARTURE IN TANK BUILDING.

Introduction.—I will commence my paper by reading a short extract from the preface to Ruskin's "Stones of Venice" (edition 1874): "On last Waterloo day, I drove on to Brentford, and walked over Kew Bridge. I could not but be solemnly impressed by the appearance of a circular temple, built since I last crossed the bridge, some thirty or forty times the size of that of Vesta, by the Tyber, which it otherwise in many particulars resembled, no less than that of the Sibyl at Tivoli. The dark walls and singularly tall and narrow columns rose sublimely against the twilight, at the extremity of the higher reach of the stream, and presented at once a monument to the art and the religion of the children of Thames; being no less beauteous a work of peace than the new gasometer of, I presume, the Brentford Gas Company, Limited. . . . . Three days afterwards, I was sleeping in the 'Greyhound Inn' at Croydon, and my bed-room commanded in the morning what was once a very lovely view over the tower of Croydon Church to the woods of Beddington and Waddon. But no fewer than seven newly-erected manufacturing chimneys stood between me and the prospect; and the circular temple of the Croydon Gas Company adorned the centre of the pastoral and sylvan scene." Observe, now comes the moral of the preachment, with its smiting counterblast. He continues: "There is not the remotest possibility of any success being obtained in any of the arts by a nation which thus delights itself in the defilement and degradation of all the best gifts of its God; which mimics the architecture of Christians, to promote the trade of poisoners; and imagines itself philosophical in substituting the worship of coal gas for that of Vesta." I thought that Vesta and Sibyl were goddesses peculiarly Roman and Pagan in their belongings, and had as much to do with Christianity as a chestnut horse with a horse-chestnut. The evolution of artificial light from a lump of coal by the intellect of man is much more one of "the best gifts of its God," than are those æsthetical vanities found in the gospel according to Ruskin; and which have to be taken mentally with a considerable "grain of salt." Take another sample brick from the same work, where he writes: "When I speak dictatorily and say this is base, or degraded, or ugly, I mean that I believe men would either think it so, or would be prevented from thinking it so, only by some morbid condition of their minds." As much as to say, when people won't agree with you, throw at them the exclamation, "You are morbid!" or, as some superior persons would remark, "You have a defective organization." So preaches the apostle of dilettanteism against the gasholder and its originators, which preachment approximates to that of the author of the "Silver King," who says: "I hate practical men. It is the dreamer who rules the world; practical men only think they do." This is what Yankees call "asininity"—a term I recently met with in an American engineering paper. We, however, can live down this sort of thing, even at the expense of being thought morbid. If critics and hard words could break bones, what a lot of cripples we should be!

Ordinary Method of Tank Construction.—I will now speak of the gasholder appendage, commonly called the tank, and complete the temple which gas folks erect "to promote the trade of poisoners." Using the same constructive materials as of old (principally brickwork and concrete), permit me to suggest a few changes in the *modus operandi* of tank building, so as to save risk and economize work. The chief source of expense in making a tank lies in the construction of the sustaining ring-wall; and gas engineers are always scheming methods to perform this in the most expert fashion. It is usually effected by forming a circular trench of earthwork, of sufficient capacity to enclose the entire wall, with its piers and foundation platform—say, for moderately large tanks, about 30 feet deep by 14 to 16 feet wide, from D to E on plan and section of the sketches—and in this shield or cofferdam to construct the wall. The trench is strongly timbered by skilled men, in such form as to cover many weeks of risk, and insure perfect safety to the work going on, and the lives employed therein. The timbering alone of the trench costs as much as 3s. 6d. per cubic yard upon the actual net quantity of earth taken out of the same; or about 1s. 9d. per cubic yard, upon the entire excavation of the tank, including the cone; and sometimes, where water is met with, from 4d. to 8d. per cubic yard extra on the total excavation for the cost of pumping. The trench must remain a safe work, and resist all contingencies and cavings-in of the sides, until the tank wall has grown into an accomplished fact. Some people there are who will be bold, and risk slips and heavy shoves of earthwork; and who meet the difficulty by merely sloping back

* See Journal, Vol. XLVI., p. 99.



the sides of the excavation, without timbering, and thus try to steal a chance of cheap success. But Nature will work her course. Exposure of the earth faces to atmosphere and moisture, swells the material; and the mass at times comes upon the half-finished wall like a miniature avalanche—playing havoc with everything, not even excluding the finances and the credit of the engineer. Supposing, however, that the wall be completed under this arrangement, by a close shave, with luck, and hurry-scurry work, the ultimate result too frequently is that, instead of the wall reposing against a solid, natural, and undisturbed earth backing, consolidated by ages, the supporting material is artificially packed behind the wall, as "made earth;" and, being out of sight, is usually scamped, with resultant settlements, cavities, leaks, and changes of wall-face.

Comparison of Methods of Construction.—We will suppose now by way of comparison, that the wall is constructed in the open-timbered and continuous all-round earthwork trench, which is usually considered as the only safe method in the long run; and then compare it with the modification thereof which I am about to propose. Let us assume, by way of example, that we require a tank for a double-lift holder, to store a million cubic feet of gas, and we adopt a diameter of 145 feet and a depth of 37½ feet net, internal dimensions. Including the foundation, 30 feet of the tank may be below, and 10 feet above the ordinary ground level of the site. This form of tank would necessitate, by the ordinary method of building, a timbered trench about 460 feet in length, taken along the centre line, by a breadth of 14 feet, so as to get in the full width of wall, piers, and bottom level, 6 feet wide to concrete foundation, (see Plan, D to E), which will enable the bricklayers to operate in front of the wall. I am assuming that the tank is built with a face of brickwork. Out of this heavily timbered trench, with its planked runners 3 inches thick, strong walings 11 in. and 9 in. by 3 in., struts 9 in. by 9 in., and props 4 in. by 4 in., we shall have to excavate at least 7000 cubic yards of earth; and which will cost for the trench alone, on an average, everything included, about 6s. per cubic yard, even in earth of fairly good quality—say a total of £2100. The trench ordinarily cubes up to about half the entire excavation of the tank. The timber in the trench requires twice fixing—viz., once to get out the excavation, and once again as the wall rises, to support the cone earth, the struts of the latter butting upon the green wall.

Suggested Method.—We will now consider another method of excavating the earth trench for the wall. Instead of adopting one large continuous trench, encircling the tank, and carrying with it the inevitable risks, let us suppose that the material be taken out in conveniently sized sections or blocks, separately timbered and completed for the concrete backing to wall, and of the form shewn on the sketch plan of one panel of the tank, and numbered 1, 2, 3, and 4. The piers or counterforts, which carry the standards, are figured 1; each having an area of 6 feet by 5 feet for the concrete portions placed radially. These are performed first; and then the three closing-blocks between the pair of piers, figured 2, 3, and 4 on plan, each 11ft. 6in. by 3ft. 6in. in rotation. Here we have in the entire tank wall, up to the ground line, 48 manageable pits to deal with, instead of one large unwieldy circular trench 460 feet by 14 feet by 30 feet. By this mode of procedure the amount of earth to be excavated from the timbered trench is less than 2000 cubic yards, instead of 7000 yards by the previous method; being only about one-fourth, or just sufficient to enclose and get in the concrete for three-fourths of the ultimate tank wall. This can be performed at 2s. 6d. per cubic yard, including timbering and all expenses, and at a total cost of less than £250. Here is a saving on the trench excavation alone of £1850, which, allowing £200 for the portion of cone included in the large trench, gives a net saving of £1650, *plus* economy of time and plant, and avoidance of risk. The pits or trenches are of small area, and only require light portable timbering, composed of polling boards, each about 3 feet by 6 inches or 7 inches by 1¼ inches, cut out of rough stuff, placed next to the earth faces; with a tier of walings and returns 9 inches by 3 inches at every framing or setting of 3 feet to 4 feet in depth of the pit; and a single small strut (merely a short cutting from a larch pole), 4 or 5 inches in diameter, and about 2ft. 9in. long, driven in tightly against the walings. The polling boards, in place of the costly planked runners, can always be used to support the earth sides when the water-level is kept below the foundation of the inlet and outlet pipes for tank trench depths of 30 feet. No tank need go deeper than this into the natural ground, as the filling above can be arranged to meet the reception of the largest holders. A setting of timber is removed from the pit for each layer of concrete, which may have a depth of from 3 to 4 feet; and, when completed, flushed and grouted on the top with fine stuff (1 to 3) and rammed well against the sides, the next layer of concrete is proceeded with by the removal of the next framing of timber above. The concrete thus deposited closes up at once to the clean, undisturbed faces of the trench, so as to retain in the earth its natural stability and cohesion, to uphold the wall and its full backing-up resistance against the bursting water pressure from the full tank. The top 10 feet of the concrete wall is reduced by a set-off of 9 inches; and here portable wooden, collapsible shutters, in sections, are used to shape the back of the wall. These are left in position for a day or so, until the concrete has hardened, when selected earth-backing is substituted for the same, rammed in layers, and watered. Or for an extra expense of about £50, concrete of the full thickness, 3 ft. 6 in., can be carried up to within 3 feet of the ground line, and "made-earth" backing almost dispensed with. Each section or pit, when filled with concrete, forms one of the horizontal arch-blocks of the tank wall. The bottom concrete layer to each block, forming its foundation, about 3 to 4 feet deep, needs no timbering, as this portion can be excavated and concreted in a few hours. The sections of wall marked 3 and 4 on plan to each bay are executed with safety, dispatch, and very little timbering; as, when the adjoining blocks (figured 1 and 2) are in place, they act as buttresses, and the earth pressure is largely removed from the trenches for 3 and 4. Operations can be going on at the same time to the four quarters of the tank, to give time for a rest of a week at least after completion, and to harden each block of concrete before closing in the adjoining ones. In setting out the tank, 4 inches extra should be given to the diameter, to allow for irregularities in the concrete face.

Previous Methods of Concreting Tanks.—I am quite aware that concrete tanks have been constructed by shooting concrete into an open, timbered, all-round, continuous trench, about 6 feet wide, and corbelled out at the top to receive the holding-down bolts of the standards, as in fig. C. The inside face of the wall was, when completed, rendered with cement and sand, and left with the face exposed to the elements. The corbel or overhang at the top (of about 2 ft. 6 in.) has a dangerous look about it, especially for concrete, and may splice off. The tank wall is necessarily bulky and overdone in material; and it has face water-tight material, without the protection of a brick wall veneer face, which, I think, is very objectionable.

Water in Foundation.—Where water is met with in the trenches, it will be necessary to provide a sumpt or pumping hole, at a convenient spot outside the tank wall; and also to use one or two of the trenches for this purpose, before filling in the concrete. All sumpts should, as a rule, be from 5 to 10 feet deeper than the

foundation of the inlet and outlet pipes—the lowest part of the tank; so as to dry up the sides of the excavation in advance of the timbering. I have often thought, although I have never seen it carried out, that the best location for sinking a sumpt would be in the centre of the tank, and through the cone; delivering the water from the pumps into shoots carried to the outside of the wall. This position would draw the water equally from all parts of the foundations.

Wall Sections.—The tank wall in this example is formed, as before stated, of 48 blocks of concrete, separately built, for a height of 30 feet, in the first instance; being the voussoirs or arch blocks, which, when completed and cemented together, constitute the horizontal arch or wall (acting similarly to the vertical arch), to uphold the earthwork behind. This anticipates future operations—such as the removal of the cone earthwork, the insertion of the concrete floor, the brick veneering and water-tighting to the concrete wall face, and the building up of the upper length entirely of brickwork to the tank wall 10 feet high above the ground level, as per section of wall A B, which is solidly backed up with made-earth, rammed in layers 6 inches thick, and well watered.

Bonding Blocks.—As the blocks of concrete figured 1 and 2 on the plan are built, there will be left on their radial joints a notch on plan 1 ft. by 6 in., using a moveable wooden template for this purpose; and this when the sections 3 and 4 are closed in and finished, will bond and cement the arch-blocks together in one compact whole.

Cost and Constituents of Concrete.—The concrete portion of the wall will cost from 10s. to 12s. per cubic yard, formed of one part of Portland cement, two parts of sand, two parts of gravel stones, and two parts of furnace clinkers and retort-brick *débris*, broken up into 2-inch cubes; the whole turned over three times dry; then mixed with water in volume equal to from one-fourth to one-fifth of the mass, according to season, and turned over twice when wetted from the rose-headed hose; and then thrown into the trench to be rammed in layers. Brickwork in Portland cement, to occupy the place of the concrete in the wall, would cost, usually, double the above value of concrete.

Hoop and Network Iron Bond.—Hoop iron 1½ in. by $\frac{1}{10}$ in. is placed at intervals of every 5 or 6 feet in height of the wall sections; the strips placed at 6-inch centres on plan edgewise, and turned up at the ends to take up and unite with the strips corresponding in the closing blocks. Or at the same intervals, place a network of ½-inch iron wires at 1-inch centres, meshed with lighter wires, and looped up at the ends to connect with adjoining blocks.

Clean Joints.—As each closing block is excavated, the radial joints of the adjoining ones are brushed and washed clean from all earthy matter to receive the fresh concrete.

Veneering, Water-Tighting, and Footing to Wall.—When taking out the earthwork for the cone, it is removed in convenient sections down to the top level of the tank platform, which is 2ft. 6in. above the wall foundation. After this those portions of the excavation at the foot, and in front of the wall are taken out, alternately, apart from each other, and completed one section at a time, on the same day—as shewn by the dotted lines on plan—to prevent any tendency, or kicking, of the wall inwards. It is preferable to construct a rigid platform of concrete at the base of the tank wall, in sections, say about 12 ft. by 6 ft. by 2 ft., and allow each to harden for a few days before the closers are formed; thus constituting, when completed, a horizontal solid ring all round the tank, to insure stability. When the floor and trenchwork concrete are completed, you can get at the face of the concrete hearting in the open daylight, to veneer and watertight the same by building up a face wall of brickwork in cement mortar, 9 inches thick, say, four to six courses in height at a time all round the tank, 2 inches clear, on plan, in front of the concrete face; or by a facing of concrete blocks, specially prepared and dried for a month in advance of the work, each 9 in. by 6 in. by 4½ in., weighing about 20 lb., set also in cement mortar. Float into the 2-inch chase or cavity between the two walls a thick compo. paste or slurry, compounded of one-and-a-half parts of finely screened sand, and one part of finely ground Portland cement, ground to pass 5000 meshes to the square inch, thoroughly mixed with water, in layers of 4½ to 6 inches deep all round the tank, slightly stirring up the same at first with a narrow tool to expel the air bubbles. As the compo. dries, but before it shows signs of hardening, gently stem or ram each layer, all round the ring, with a light rammer, scored on the underside to leave the chase surface rough, for keying into the next layer. Each time a course of watertight material is deposited in the chase, the latter should be first well moistened (but not saturated) with water, from a rose-headed jet. In fact, the whole of the tank materials should be kept well watered during construction; and as long as the moisture will disappear quickly into the body of the wall, and not flood the same, water, with cement and sand grout, can be used with advantage; so that when cold water is run into the tank at the finish, a contraction and shock will not take place in the concrete wall, by inducing further chemical action and movement in the cement and sand. Watertight material, of cement and sand 1 to 1½, sandwich fashion, is also enclosed in the concrete and cone covering, 3 inches thick, and united to the wall chase, as shewn on section of wall A B, so as to make the tank a complete water-tight basin. This method of water-tighting is preferable to that of merely rendering the faces of the tank wall and cone with two or three coats of cement and sand plaster; for, as we all know, face cement rendering, like face puddle, or any other face watertight expedient, is not permanently weather and temperature proof; always moving minutely on its exposed face, refusing to combine with and key into the coarse materials beneath, developing hair lines and cracks for future leaks, and probably to peel off ultimately. No face work is better for tanks than a good, sound, vitrified, brick wall, set in cement mortar, fronting and protecting the water-tight material.

Composition of Water-Tight Material.—I may mention that it is an improvement to the water-tight compo. to use therein a pound or two of coarse, unrefined, black sugar to each bushel of cement—something like 1 to 2 per cent., by weight, of the cement used. The sugar slightly retards the setting of the cement, and tends to make the compo. tougher and somewhat glutinous. It is still further improved either by the addition of 1 lb. of coarse whole-meal flour, or 1 lb. of what Scotchmen are largely compounded—oatmeal—to each bushel of cement, if you can afford it. Or take one part of furnace slag meal, ground to an impalpable powder, as manufactured and screened, it is said, to a mesh of 10,000 to a square inch (100 × 100); one-and-a half parts of fine sand, screened through a sieve of 1600 meshes to the square inch (40 × 40), wires of same gauge as the mesh; one-tenth of a part of oxide of iron; and one part of fine Portland cement (5000 meshes to the square inch) thoroughly mixed with a volume of water equal to about one-fourth of the solids, into a fluid compo. The free lime of the cement combines with the finely ground silica of the slag, and prevents the lime-juice from sweating through the wall.

Proportions of Tank Walls.—It must not be forgotten that in proportioning the thickness of the concrete wall backing, we must be governed by what is necessary to resist the external earth pressure when the tank is empty, and so as to ensure a working safety factor of (say) 4 to the wall. Thus it may be taken as a safe rule, where the earth is fairly compact, that the mean thickness of the finished wall materials for the panels, between piers, should not be less than about one-tenth of the total height of the wall, for tanks up to 36 feet in depth, and with an inside diameter of 150 feet; but for larger tanks, the mean thickness of the wall panels should be equal to one-eighth of the height. The piers or counterforts should have a thickness, radially, of not less than one-fifth, and a breadth of about one-seventh, of the total height of the wall. These proportions are based upon the assumption that brickwork and concrete in cement are the wall materials, and not in lime.

Advantages of Sectional Method of Building.—The sectional method of building tanks has the advantage of any other system where water is met with copiously in the foundations; and which may cost anything to pump out from 4d. to 8d. per cubic yard rated over the total excavation of the tank. It restricts the surface area for percolation. There need not be in operation at one time more than from four to six out of a total of 48 trenches. Thus should the pumps break down, the work can be stopped at once, and the resulting damages will be something next to *nil*. The central cone of earth forms the shield to the wall blocks during construction and hardening; and the thrust of the earth upon the wall is arrested until completion, and the timber and plant are set free again and again to perform duty. The quantity of timber used for the trench work is not more than about 10 per cent. of what would be necessary for large, all-round trenches. You can sink and concrete one of these blocks in two or three days; and have the bottom portion of the same cut out quickly and sealed with concrete on the same day. There is no fear as to slips, cavings-in, jackings-up of timbers, cavities behind walls, and the other calamities which are incidental to the one, all-round trench system. I have carried out this method of separate *versus* continuous trenchwork, so far as to use as many as 160 blocks of concrete to form the foundations for one superstructure of a building, and so limit the areas of difficult work, with an economy of time and material, as well as multiplying the work faces, and eliminating risk.

Importance of Natural-Earth Backing.—Most of the tank walls which have cracked after use, have probably been cursed with imperfect earth-backing; the natural soil having been taken out too fully from behind the wall, and substituted by loose stuff or no stuff at all; the earth faces too long exposed to moisture and air; and consequently the wall has been put under severe tensile strain from the bursting pressure of the tank water. All who have opened out the backs of tank walls to search for leaks, know painfully the honeycombings and cavities they have met with; and the proofs of the intense desire on the workman's part to scamp all work which will be covered up and out of sight, even when he is an "old hand," and is paid "daywork." Ordinary earths undisturbed—such as clay, marl, gravel, binding sand, &c.—will carry a safe load, without settlement, of from 2 to 5 tons per superficial foot of surface. Now, if we preserve this natural-earth resistance from lateral movements, by careful timbering and despatch in the trench, it will hold the wall free from all tensile or bursting strain from heads of water of 80 feet and upwards in the tank; or say 2 tons per superficial foot of surface at least. But if the backing behind the wall be of made earth, its resistance will not be one-fourth of this.

The Radial or Arch Joint to Concrete Blocks.—The frequency of the radial joint in the tank wall, at the junctions of the concrete blocks, is not an evil, as it gives points of easement in the early periods of settlement, and prevents those shrinkage cracks so often visible on concrete walls formed in one monolith. This radial or arch joint is covered by the tenon or notch-bond shown on the plan; and also by the layers of hoop iron, used at 5-feet intervals in height, running round the wall. I never knew a properly

designed concrete wall, where hoop iron was judiciously introduced which showed cracks on the face; and I never saw one built without hoop iron, which exhibited a clean, uncracked exterior.

Summary.—To recapitulate. There are three motives in the present paper: 1. To construct the wall in trenches and sections of convenient sizes, instead of in one all-round trench, and in one monolithic block; thus insuring sound earth backing to the wall, safe wall settlements, a minimum of expense, plant, and risk, with expedition in the work. The sections or blocks, when united, form the voussoirs of the horizontal arch, or retaining-ring wall of the tank. 2. The building of the face wall, with its compressed water-tight backing, in the open daylight, after the completion of the main or concrete portion of tank wall, because it is more easily performed and inspected than in the trench. 3. To maintain and preserve especially the stability of the natural earth as a backing to the wall, to resist the bursting water pressure of the full tank; leaving to the wall the sole duty of retaining the earth during construction. The wall material then is only strained in compression and not in tension. Brickwork and concrete in cement of the usual character combined in walls will take a maximum compressive strain of from 35 to 40 tons per square foot; but only a tensile strain of about one-tenth of this, or, say, 4 tons per square foot of wall sectional area. The maximum compressive strength of the tank wall in the example is equal to 12,000 tons; whereas its tensile strength is only 1200 tons.

Formulæ.—The formula for the tensile strength of the tank wall is 2HCT =

2 walls × 37½ ft. × 4 tons × 4 ft.	=	1200 tons
The hoop-iron in wall + gravity of wall as a retaining wall = ¾ of above	=	900 ,,
Total		2100 tons.

The formula for the total bursting pressure from the water in the tank is DHP = 145 feet × 37½ feet × ½ ton = 2718 tons. The bursting pressure is thus in excess of the maximum tensile strength of walls, although the latter have more than the usual thickness. We require here a factor of safety of 4, or a resistance of 2718 × 4 = 10,872 tons. To obtain this, we must supplement the wall tensile strength by the earth backing or lateral support, equal to 10,872−2100 = 8772 tons. The earth backing can be depended upon as a buttress to the extent of at least 2 tons per square foot of face *when its natural cohesion is preserved*, but as *made earth*, only one-fourth of this, and that not immediately. By the formula D × H × 2 tons = 145 feet × 37½ feet × 2 = 10,874 tons, which, added to the 2100 tons above for the tensile strength of wall, gives a total resistance of 12,974 tons to the wall and backing, or a factor of safety of $\frac{12,974}{2718}$ = 4·77, or nearly 5 to 1.

The formula for the maximum *compressive* strength of the two wall sections on opposite sides of tank is $2HTC^1$ = 2 × 37½ feet × 4 feet × 40 tons = 12,000 tons. Against this we have, when the tank is empty, the earth slope lateral pressure behind the wall, which may be taken, for ordinary *made earth* in a moist condition, as ¾ of the water pressure of the same height as bank=2718 tons as above × 0·75 = 2038½ tons, and $\frac{12,000}{2038}$ = a factor of safety of 5·88, or nearly 6·1 + gravity of wall.

C = Constant for tensile strength of wall = in example 40 tons per square foot of wall section.
C_1 = Constant for *compressive* strength of wall = in example 40 tons per square foot of wall section.
D = Diameter of tank in feet = 145 in example.
H = Height of wall above floor of tank = 37½ feet.
P = Mean pressure of water per square foot of wall surface = ½ ton in example.
T = Thickness (mean) of wall = 4 feet.

Cost of Tank.—The cost of the tank, as per example, for a holder to store one million cubic feet of gas, at fair prices, would be £4 10s. 6d. per 1000 cubic feet of storeage, in average soil; and £4 16s. 6d. where water is met with copiously in foundation.

Mr. Wyatt exhibited a specimen of the fine sand he had referred to in the paper, remarking that he did not know why, but his mortar was always best with fine, clean sand.

Discussion.

The President said that Mr. Wyatt's paper would be of very considerable interest to most of them. It was certainly not every day that a gas manager had a tank to construct; and for that reason, when he had one, he needed to fortify himself with all the experiences and hints as to construction that could possibly be obtained from brother managers. Personally, he had not had a great deal to do in the erection of concrete tanks, although he had used concrete for many other purposes; but he was a great advocate of concrete. He believed that, where the materials could be had at anything like a reasonable price, and where the circumstances were suitable, nothing better or cheaper could be used. Mr. Wyatt had brought out many points in his paper that, no doubt, would have their attention, and which, on carefully weighing them at their leisure, they should more fully appreciate.

Mr. R. Smith (Leeds) observed that he thought the paper so important that it was almost impossible to criticize it without having some time to consider it.

Mr. Wyatt remarked that it was too frequently thought by engineers that, the larger the work to be carried out, the cheaper it could be done. He had had a large experience in tank foundation pits; and he found that this was not always the case. He had found that he could make a small, manageable pit—say 6 feet by 6 feet, by 10 yards deep—cheaper than any other kind of pit, because they could do it quicker. A large pit required more timbering, as the earthwork was always coming in.

Mr. Watson (Gateshead) asked Mr. Wyatt if he could tell them what took place when he mixed oatmeal with concrete, and how it improved it.

Mr. Wyatt replied that, when they wanted to block a leak, they put in some fibrous material. The reason he suggested oatmeal, as well as sugar, was this—the sugar would run freely, but oatmeal had a certain amount of fibrous, or glutinous tendency in it, which improved the cement. It only required 1 or 2 per cent.; and although it weakened the cement to that extent, it made it more water-tight. He should not use it for brickwork. He had seen the contractors, when finishing the water-works at Birmingham, ramming almost dry meal into the work. This he objected to, because, unless they gave a sufficient quantity of water to cement, it would never do its duty in setting; and when water afterwards came through, it was apt to produce cracks.

Mr. R. Bridge (Doncaster) said he was very pleased with Mr. Wyatt's paper, and thought they were all much indebted to him for it. He should like Mr. Wyatt to tell them whether he had any difficulty in regard to the union of the sections in passing round the tank. If he understood rightly, one section was brought up from the foundation to the top; and then another section was commenced at the foundation. Was there any difficulty in the bonding or the union of the two sections, whether from the earth-pressure at the back of the wall, or from the settling of the structure? Presumably the first section, after it was finished, would have settled somewhat into the foundation. The next section would also commence to settle, but not, he should say, at the same time as the first.

Mr. Wyatt said, in order to partly obviate that difficulty—although he should not do it himself—another notch could be put into the wall. They saw he put a notch in the radial joint, which gave him a key from top to bottom, of 12 by 6. This held the radial arch like a key-stone; and consequently it could not come forward. The only question was as to going downwards; and concrete, after one week, never moved, except the foundation shifted. If cement moved—either expanded or contracted—they condemned it; but even if it did, they had a radial, or tying tail-joint to keep it.

Mr. W. J. Warner (South Shields) agreed with all that Mr. Wyatt advanced, as far as the broad principle of construction was concerned. Some years ago, in putting down a couple of tanks at Jarrow, he laid down his plans almost upon the same principle. It appeared to him to be obvious that, in carrying up a structure in such a way, they were bound to have the work better done, firmer, and still giving points of easement, which, he quite agreed with Mr. Wyatt, were very necessary in every concrete structure. The vertical joint forming these easements, which he adopted at Jarrow, was scarcely the same as Mr. Wyatt's; inasmuch as he threw out a footing from each of the pillars, and made them somewhat wedge-shaped. These tanks were built in clay, and were, therefore, perfectly sound; and he did not think there was any fracture whatever in them. The concrete was put in in the usual way. He was afraid that, with reference to the iron bond, he was obliged to go into the opposite school. It was a point that was well debated a good many years ago; and he was inclined to trust to concrete itself to do its work. He would rather use, as he had always done, brickwork as a binding material, rather than the concrete itself. He would certainly prefer in that neighbourhood, putting up the pillars of good, common fire-brick, building them well in in cement, and then afterwards filling in with the concrete between the pillars. He did not think there was any strict necessity for veneering the wall. It was an old principle—first used by Mr. King at Liverpool, where he excavated out of the solid rock. He himself had used it in connection with a rough rubble wall, in which case, he thought, it was an advantage. He would rather prefer to make an intervening space, or pocket, of asphalte. His method was to dip the bricks in hot tar, put them in place, and then fill in with tar behind. This was the only way, he found, by which he could resist water. He did this, he might say, after the tanks were put in. He was very much interested and pleased with Mr. Wyatt's paper; having worked somewhat on the same lines.

Mr. J. Hepworth (Carlisle) said he could not help expressing his appreciation of the communication which had been laid before them. He was an old worker in concrete, both in the construction of gasholder tanks and reservoirs; but he thought he had learned something from the paper that morning. The general principles which Mr. Wyatt had set forth were such as would commend themselves to them all. There could be no question as to the utility of Mr. Wyatt's method; and the cheapness of a tank would be very much promoted by it. He was exceedingly interested in hearing Mr. Wyatt's description of his water-tight material, because he himself clung to the prejudice of coating his tanks with pure cement, and relying upon that as the agent for preventing leakage. But the simplicity of the plan which Mr. Wyatt had suggested, made it worthy of the attention of all of them. He was very glad to hear the reply given to Mr. Bridge. When the paper was being read, he did not quite gather how the shrinkage was to be provided against; but Mr. Wyatt had now told them that, in one direction there would be no shrinkage at all—that if there was in one way, it would strengthen the structure, and, if in the other way, it would be vertical; but it would not take place after the lapse of a week's time. The only point not clear to him then

was whether Mr. Wyatt constructed the whole foundation of the sections between the pillars first; and, if not, why not?

Mr. WYATT: Oh, no! There is no communication whatever but what the pillars themselves give.

Mr. HEPWORTH thought that then, if they were working upon treacherous ground, they would have to make very special preparations for dealing with the surrounding earthwork, when they were constructing the uprights. Mr. Wyatt's experience was so much larger than theirs that he might tell them whether, in the event of a shifty foundation, there was any need whatever to risk that, or whether he would simply go on building his base, then trough it, and go on with the next section—trusting, in the same way, to the weight of the material finding its own base. It was a pity that this subject could not be taken up at a subsequent meeting; seeing that the paper had not been submitted to them in print before the meeting. He did not think there was anything more that he could add to the discussion, but nothing could increase the gratitude which he felt to Mr. Wyatt for that day, as in times past, bringing before them a paper upon constructive work.

Mr. WYATT replied that, when they dug down to the depth they had to go, they invariably met with a material upon which they could place a heavy weight. The only thing they had to avoid was water; but, as he had pointed out, if they pumped, they would find a dry foundation. They might put upon ballast an almost incredible weight, because, at such a depth, it became so compact that no reasonable weight they could put upon it would ever compress it. They could not alter the form of the block after it was set. It had assumed a form and a shape which would never change; and the new cement put in at the sides would form a bond to it. It was not correct to say that iron and cement would not go together; because he had tested it for compression strain, and he could get four times the duty of concrete, at an expense of about one-fourth the cost. But, in addition, the iron gave it a tensile strength. It seemed to develop the strength of the concrete, though they could not tell how it did so.

The PRESIDENT, in closing the discussion, said he would just add some strange experiences he had had with asphalting and concrete. In his earlier days, he was located in the neighbourhood of Low Moor; and one day when they were making asphalte, a workman suggested that he might take some of the "rolling sweepings," and put into the asphalte. He put in three or four shovelfuls; and it resulted, not only in the asphalte setting very much quicker, but, when it had set, it was almost like iron itself—it was next to impossible to get a pick into it. The idea occurred to him in making concrete, that he might with advantage do the same thing; and he tried it with almost the same result. He could to some extent diminish the quantity of cement used; and he obtained a considerably harder cement, which would stand a good deal more strain. He merely mentioned this because he knew that many of them could not have the opportunity of doing it, as he had. It was certainly used with very great advantage. He had no doubt they would all agree with him that Mr. Wyatt in his paper had put matters before them which would not only be of advantage to them just now, but which would be of very great benefit to them in times of extension, either in the way of tank-building or in erections in which concrete was required; and for this reason he had very great pleasure in proposing that the best thanks of the meeting be given to Mr. Wyatt for his very able paper.

The proposal was heartily agreed to.

A NEW JOINT.

The PRESIDENT said the only other matter before them was a novelty in the way of a pipe-joint, introduced by Mr. Pettigrew, of Darlington, and specimens of which were on the table. Mr. Pettigrew was one of their members. To his mind, this pipe-joint was a step in the right direction, more particularly for men who, like himself, were located in towns that were mostly built upon ballast, where the pipes were liable to constant movement. In West Hartlepool, the bulk of the lower portions of the town was ballasted up to a height of from 6 to 10 feet—the lower parts with sea shingle, and the upper parts with furnace refuse. They had very considerable annoyance from their pipes constantly moving. He could show them places where as much difference as from 2 to 3 feet had taken place in the line of a pipe; and only quite recently, in taking up a 15-inch pipe, it was almost impossible to make a section of it—it was all hills and holes together. It seemed to him that this pipe-joint would obviate many of the difficulties that one had to contend with in laying mains.

Mr. WYATT said it was wonderful what ordinary lead joints of from 4 to 5 inches would do. In the subway from Blackfriars Bridge to Westminster, they had a 3-feet pipe; and when it was first constructed, the tidal water got in, and the pipe used to float on the water like a huge snake, rising and falling somewhere about 8 feet—the gas going through the whole time. There was, however, some leakage.

Mr. PETTIGREW, in describing his joint, said he had, during the past two years, laid 16½ miles of pipes with this joint, at 2d. per yard less than the ordinary joint. Pressure from within had the effect of making the joint more secure; and the same action took place when there was any movement on the pipe. It took half the length of socket of the ordinary joint; and there was consequently a great saving in lead.

Mr. WYATT remarked that he thought there was no disadvantage in a little drawing.

Mr. PETTIGREW said that was not his experience. He might mention that this joint had been used at Hexham, in connection with a pipe which was subjected to nearly 900 feet of pressure. This was the heaviest pressure to which it had been subjected.

Mr. J. A. G. ROSS (Newcastle) thought it was a joint which would be very suitable for hydraulic work, or for conveying power.

UNIFORMITY IN RETORTS.

Mr. G. A. ALLAN (Wallsend) asked if anything had been done in the way of communicating with kindred Associations with reference to the adoption of a standard size of retorts.

The PRESIDENT said he did not think that anything further had been done.

Mr. ALLAN suggested that the Committee should communicate with the other District Associations on the subject during the next six months.

VOTES OF THANKS.

Mr. HEPWORTH said they had received very great service from their President during his year of office; and he begged to propose a vote of thanks to him.

The proposition was carried with applause.

The PRESIDENT said he was extremely obliged to the members for their kind vote. It had been a great pleasure to him to do anything he could for the well-being of the Association; and if what little he had done, were appreciated, he was perfectly satisfied. He could only say that, throughout his year of office, he had had the support of every member of the Association, and particularly that of their Secretary, Mr. Hardie, who, at all times, had kept him right when he was inclined to go wrong. He thought Mr. Hardie was a very proper man for his place—one whom any President would have a pleasure in working with; and he begged to propose a vote of thanks to him for his services.

Mr. W. FORD (Stockton) said he had much pleasure in seconding the motion; and at the same time he expressed his regret that he himself had again been returned to office, because, in his opinion, they should have fresh blood in the Committee.

Mr. HARDIE, in returning thanks, said he quite agreed with Mr. Ford, and humorously suggested that, if changes were to be made, the Association might take into consideration whether they should not have a change of government altogether.

The members afterwards dined in the County Hotel. Mr. Bower occupied the chair; and he incidentally remarked that he had omitted to mention, during the business portion of their proceedings, that the next meeting was to be held at Doncaster, where, he had no doubt, they would receive a hearty welcome.

MEETING OF SCOTTISH GAS MANAGERS IN GLASGOW.

The Sixth Annual ("Informal") Meeting of Scotch Gas Managers, chiefly connected with gas-works in the western and immediately adjoining counties, was held last Thursday, at the Langham Hotel, Glasgow. These meetings, as readers of the JOURNAL are aware, were instituted when the West of Scotland Association of Gas Managers ceased to have a separate existence; and their chief aim is to maintain a friendly feeling amongst the members of the gas profession. They are always held in Glasgow. There is no organization in any way—no Council or Committee—but there is a sort of standing Convener, who was himself for a time the Secretary of the defunct Association, and subsequently its President. The gentleman in question is Mr. James M'Gilchrist, Engineer and Manager of the Corporation Gas-Works, Dumbarton. As there is no organization in the shape of an Association, so there is no President; but at the meeting of one year a Chairman is appointed to preside over the following one. On the present occasion, Mr. W. Mackenzie, of Dunfermline, should have presided; but illness prevented. On hearing of this gentleman's inability to attend, the Convener applied to Mr. John M'Crae, of Dundee, who at once came to his aid in the emergency. In addition to the Chairman and Convener, there were present representatives of the gas profession from a large number of towns; and altogether it was a highly interesting meeting.

The CONVENER opened the business by reading a letter from Mr. Mackenzie, apologizing for his absence, and expressing his desire that there might be an excellent meeting.

CHAIRMAN'S ADDRESS.

Mr. M'CRAE then took the chair, and proceeded with his opening address, which had been prepared specially with the view of stimulating discussion on the points dealt with. He said that in appearing before them, as Chairman of this meeting of gas engineers and managers, he felt quite out of the place he had the desire or right to occupy; and therefore his feelings were not of the pleasantest. Never having been a member of the West of Scotland Association of Gas Managers, and knowing that that Association contained many gentlemen of known ability, made his position all the more embarrassing; and then again, having the knowledge that the President for this year was such a general favourite, still further made his position one of difficulty. He was sure he simply expressed the feelings of every one present when he said how much they regretted the absence of Mr. Mackenzie, of Dunfermline; still more did they regret the cause of his absence. They would hope that the illness which had been his for so long a time would pass away, and leave him with his wonted vigour and energy to fill the position he had so well, so long, and so faithfully filled. Proceeding, he said he did not suppose they expected from him an elaborate or technical address. In the first place, his ability might step in the way of this being performed; and, in the second place,

the two or three days' notice he had had simply prevented such an appearance. But his experience of gas managers led him to believe that they appreciated much more a practical conversation with their practical friends, than an elaborate or controversial discussion upon any doubtful or abstruse subject. Three years ago, when he appeared before them, he indicated that the regenerative furnace would in a very short time be largely adopted in gas-works of every magnitude. He thought it would be agreed that such had been the case. The furnaces, especially in the case of those applicable to smaller works, had been much simplified in their details; and the excavations and resulting tunnels had been almost done away with. That was greatly desired, as few managers of works of ordinary magnitude viewed with much favour the complete remodelling of their works, and the erection of large buildings and machinery simply for the purpose of effecting a saving of fuel. The case was different in large towns or cities, where considerable extensions of producing plant was necessary. In these cases, it was certainly advisable to carry out such extensions on the most modern principles. The experience obtained in these large towns and cities was undoubtedly of value in perfecting the furnaces which in a few years were to be designed and erected in works of less magnitude. But yet they had not arrived at perfection. There was still too much heat in the main flues, and consequently wasted; and it would surprise him much if something was not very shortly done in the direction of recovering, or making use of, some further portion of the so-called waste gases. He had always advocated the employment of the furnace with the inside producer, so that as much of the heat as possible might be conserved, and thereby be to a greater or less extent made use of; and he would add that his own experience had not in any way or in any degree changed his opinion. Before leaving this part of his subject, he would just add that it had always appeared to him that those modern appliances which ought and might be seen in every well-regulated large gas-works, should be found working as successfully in other and smaller works. And it had often been said that, if the retorts and retort-houses were neglected, the manager had all his work to make his company a paying concern; unless, indeed, he or they were placed under most exceptional circumstances. In regard to condensation, it was, he remarked, matter for regret that, although the subject was taken up by a scientific institution, it had not, so far as he was aware, reached the stage when the exact data could be given for the extent to which condensation should be carried out; nor did he think such data could be very easily arrived at. One very important factor in the case lay in the nature and component parts of the gas they were dealing with. That must be so; and in Scotland they had proved the fact that too rich gas would, by sudden or severe condensation, suffer greatly more than would a gas of lower quality. Speaking of condensing and condensers, he said that a comparatively new idea was gaining ground—namely, that the tar carried forward to the condensers, and suspended in the crude gas, could only be perfectly removed by friction. Apparatus was now being manufactured by several firms for accomplishing this object. In most of these machines the gas was passed, or rather forced, through a large number of small apertures. In doing this, whether under water or not, the objectionable material was left behind, and so the purification was assisted. In reference to purifiers and purifying, one fact had come very forcibly before him in the Dundee Gas-Works during last winter. Never had he seen so forcibly the great desirability, as well as the economy, of having ample area of purifiers. At the dead of winter when their make of gas was averaging about 2,350,000 cubic feet daily, they had to change the material (lime and oxide) from two purifiers every day—a very expensive and unsatisfactory state of matters. Now take the condition of things at the beginning of April, when the daily production of gas averaged about 900,000 cubic feet. They had only to change a purifier about once in every two weeks; or, in other words, they could, during April, purify three-eighths of the gas they did at the dead of winter at 1-26th part of the cost for labour. Of course, they could easily believe this state of matters would not be allowed to exist long; indeed, there was now in hand a large extension of their purifying area. It was not a little surprising, however, that, even on the recommendation of their experienced engineers, many companies and corporations maintained the losing and short-sighted policy of restricting the capacity of the purifying plant in their gas-works. Coming to the question of distribution and leakage, several points occurred to him, which, he thought, had not received the attention of gas engineers which they deserved. It must have appeared to many engineers when perusing published returns of gas-works statistics that the variation in the leakage in different gas-works was most annoying and unsatisfactory. To observe the leakage in two works under equally good management—stated at tremendously different rates—seemed to him to require some explanation. He thought there might exist some reasons for the discrepancy. First, the consumers' meters might be old and incorrect; and every company or corporation might not be spending the same annual sum on renewals or repairs. It would be found that every pound spent in this direction was well spent; and it would also be found that such investigation or examination as he had indicated would be very interesting, and strange discoveries were sometimes made. Secondly, the temperature of the gas, when being measured at the works, was also a most important point, and one which ought not to be lost sight of. It must be apparent to every one that if the gas was measured at the works at a temperature of (say) 60° to 70° Fahr., and immediately passed into the gasholders and main pipes, which at the moment might be exposed to a temperature several degrees below freezing, the loss by shrinkage or reduction of bulk must be great, and that loss by shrinkage or reduction of bulk must become less in precisely the same ratio as the temperature was reduced at the point of measurement. The question then put itself: Why did the temperature at the point indicated vary? If the purifiers were too limited for the quantity of gas being produced, it followed that the rapidity at which the gas was passing through them must be accelerated; and consequently the temperature of the gas at the station meter must be higher than if the gas was permitted to pass gently through the purifiers, allowing the cooling as well as the purifying processes to be carried on simultaneously. The material employed in purifying the gas also formed an important item in the matter of temperature. If lime was exclusively employed, the temperature at the point of measurement would be several degrees—probably as many as 15°—higher than if the cooler material oxide of iron was employed; and that fact was worthy of note. Then the third point was the correctness of the station meter itself. That should be from time to time ascertained, as, in his (the Chairman's) experience, the very best station meter would, after a few years' working, become faulty. If all these points were carefully observed and adjusted upon sound principles, he thought they would see smaller variations in the returns under the head of "unaccounted-for gas." The distribution of gas must always receive a great amount of their attention, as it was the largest department of any gas undertaking, and by far the most complicated. They had to deal with this matter from the opening of the streets for the discovery of some broken gas-pipe to the selection of the most suitable burners for the finest drawing-rooms, and from the painting of a lamp pillar to giving instructions as to how to cook by gas a roast of beef or anything else. It brought them all into constant touch with the gas consumers, which class, like most other classes, were not always very considerate; but his experience had taught him that, with a uniform kindness and courtesy on the part of the gas manager and his subordinates, the wrath of any gas consumer would be very much toned down. It was to his hearers, he said, a matter of great satisfaction he was sure that prices of secondary products were somewhat on the rise. All round, prices were firmer; and they were hopeful that such would continue, although it was really a matter of speculation, and could not be spoken of with any degree of certainty. There were many other points of much interest to which he might and probably ought to refer; but he thought the scope of such a paper as his was—containing only a few rambling remarks—was not intended to cover further points than those he had very imperfectly placed before them. He could not resume his seat, however, without congratulating that and many other similar institutions upon the unity of purpose and good feeling which had characterized all their doings. Such institutions were formed for the improvement of the gas profession, and also to assist in securing that the great public whom they served should recognize in them a body of earnest men, working hard to improve themselves, so that their labours—which were always for the good of the public—might be conducted on more modern and improved principles. Any institutions that had not these points as their aim were not fulfilling their legitimate purpose. Disputes, differences, or waste of time in the conduct of any institutions were most objectionable, and quite unnecessary. One word about the traders. He was sure his hearers were always glad to see them amongst them; they had assisted them on many occasions; and he thought they ought to remember that. He must be a bold engineer indeed, who would say that he was never assisted by a trader. In his opinion, they had done much to bring gas plant—from the retort to the burner—to the perfection it had now reached.

Mr. M'GILCHRIST, in proposing a vote of thanks to the Chairman for his excellent and very suggestive address, quoted the proverb as to "luck in leisure," and referred to the fact that Mr. M'Crae had come to his aid at very short notice, and that although he had not had the proverbial leisure for the preparation of an opening address, the one to which they had listened, which was worthy of the occasion, was of such a character that he personally had not much fault to find with it. He hoped, however, that many of the gentlemen present would be induced to say something regarding it, and give Mr. M'Crae a "slating" if they thought any of his remarks and suggestions deserved it. As for himself, he heartily congratulated the Chairman on his address.

Mr. M'CRAE briefly acknowledged the vote of thanks.

Mr. M'GILCHRIST then went on to refer to an "aside" reference which the Chairman had made in regard to new meters in Dundee, which had been proved to be "slow" to the extent of 70 per cent. The question with him came to be, How were they to get over such a difficulty? He urged that the indices should be tested and certified as being correct, as well as the meters themselves. It was his opinion that the influence of the gas profession should be brought to bear on Parliament in regard to the matter in question.

The CHAIRMAN, referring to certain remarks in his address delivered three years ago at the Dundee meeting of the North British Association of Gas Managers, said that two Edinburgh firms of meter manufacturers were testing all the indices of the meters they sent out; and he stated that the Government had the matter in hand. He expected that by-and-by it would be made imperative on all meter manufacturers that the indices as well as the meters should be tested and certified.

Mr. A. MACPHERSON (Kirkcaldy) continued the discussion of the

various matters dealt with in the address. Referring to the question of the cooling of gas in relation to the amount of what was unaccounted for, he urged the desirability of not over-condensing the gas. He would not condense it down to a temperature of (say) 40° Fahr., as was the practice with some managers. By doing so they were sure to take out of it certain of the hydrocarbons which ought to be retained, but which were given to the tar distiller. They should keep this material, and rather let it fall within the gasholders, where it would condense and accumulate on the surface of the water in the tanks, ready to be taken up and absorbed by the gas in summer weather. With regard to the question of meter indices, he said he was aware that some of the meter makers in Scotland were regularly testing the indices, as they were of opinion that the Sale of Gas Act was defective on this point. The action of these makers was purely voluntary. As to the secondary products of gas manufacture, while he was himself pleased at the advance in prices, he was of opinion that they were not likely again to get such high rates as they obtained for them a few years ago. On the question of admitting traders connected with the gas industry to membership of their professional organizations, he entirely agreed with the remarks of the Chairman, and he expressed the hope that such gentlemen would always be welcome amongst them at their meetings. Mr. MacPherson also had something to say regarding the utilization of the heat from the retort-flues in cases where regenerative systems of firing are employed. There would be something more to be said later on as to his own attempts at economizing heat in this direction. He hoped that eventually it would be possible to have the air discharged from the main flues of the retort-settings at a very low temperature, comparatively speaking. This was a direction in which, he thought, much might yet be done by gas managers who now employed regenerative systems of firing.

Mr. R. S. Carlow (Arbroath), remarking that his town had been incidentally mentioned by the Chairman in connection with one of the points on which he had spoken, proceeded to state what he had advised the Arbroath Gas Commissioners in regard to the extension and improvement of the works under his charge. One of his recommendations was that they should adopt regenerative firing, and another that they should provide additional holder room, for more was certainly wanted; but the provision of additional holder accommodation was the first thing to be done. After referring at some length to the variation of level in Arbroath, and to the wide range of pressure that had to be maintained in order to suit the wants of the gas consumers in different parts of the town, he remarked that great economy might be expected to result if his advice were acted upon. His recommendations also had reference to the improvement of the purifiers, which were in a very unsatisfactory state. It had been settled that in the meantime nothing should be done; but he (Mr. Carlow) had no doubt that eventually the present gas-works at Arbroath would undergo improvement. The opinion of the local people (or, at least, some of them) had to be considered. There was a feeling amongst them that it would be bad policy to lay out a great amount of money in extending and renovating the gas-works, in view of the "light of the future" making such progress as to render the expenditure of capital useless. The Arbroath people were concerned at the great preparations now being made at Deptford for extending electric lighting in the Metropolis, and at the movement in connection with water gas; and consequently he did not expect there would be any outlay on the gas-works for a year or two. But he confidently hoped that the Arbroath Gas Commissioners would in time effect all the improvements he had recommended.

Mr. Thomas Wilson (Coatbridge), as a manufacturer of residual products, was able to speak with some authority on the question of the condensation of gas. He remarked that it was a case of "tar-well against gasholder;" and he spoke of the relative amounts of naphtha obtainable in summer and in winter. He subsequently related a curious experience he had had at the Coatbridge Gas-Works in the use of lime and oxide of iron in his purifiers—in one instance having an explosion when he was using oxide.

Mr. T. D. Hall (Montrose) complimented the Chairman on the character of his address, and subsequently went on to make some remarks on the use of lime and oxide of iron in purification; mentioning that he had had much trouble during the past winter with his gas, which changed in quality during the evening. As to keeping up the temperature of the gas during the process of condensation and measurement to about 50° Fahr., he desired to know how this was to be done in small works, especially when the temperature of the atmosphere was down at (say) 32° Fahr. Like Mr. Wilson, he also had had a case of the oxide of iron firing; but it was in a hot climate. The finely divided sulphur in the oxide took fire; but there was no actual explosion. He referred to another case of the oxide firing by a current of air being let into the purifier.

At this stage of the proceedings, Messrs. MacPherson and Wilson had a little "passage of arms"—quite good-naturedly—in reference to the temperature at which gas should be passed through the condensers, whether the process should be conducted gradually or rapidly, and the relative qualities of shale gas and cannel gas in respect to the quantities of condensable hydrocarbons which they contain. Mr. MacPherson was decidedly in favour of gradual cooling, so that as much of the hydrocarbon vapours as possible might be retained in the gas. Mr. Wilson, in the course of his remarks, stated that, during the 8½ years he had been Manager of the Coatbridge Gas-Works, he had never found it necessary to pump any of his syphons; so that, wherever the condensed vapours were to be found, they were not to be found there.

The Chairman then replied on the whole discussion. He confessed that he felt quite comfortable under the "slating" which Mr. M'Gilchrist had suggested that he should get if there was occasion for it. Some controversial matter had been introduced into the discussion by Messrs. MacPherson and Wilson; but he did not follow these gentlemen into it. He confessed that he could not understand how, according to Mr. Hall's statement, gas could depreciate in illuminating power in the course of an evening. He also briefly noticed the question of shale gas *versus* cannel gas; and passed on to refer to the remarks that had been made regarding traders as members of Associations of Gas Managers. Such persons had, he said, often been called in by gas managers to give them friendly and professional advice, which had been freely imparted. Gas managers were not to regard themselves as "head and shoulders" better than these gentlemen, whom they should consider quite worthy of associating with themselves on equal terms. He concluded by thanking those present for their attendance, and for their criticism of his address.

At the request of Mr. M'Gilchrist,

Mr. R. Hamilton, Inspector of Public Lighting for Glasgow, proceeded to state some interesting facts regarding the lighting under his charge; doing so without having received any previous intimation on the matter. As to electricity for lighting streets, he would advise the Arbroath Gas Commissioners and the gentlemen present to disregard it, as it could not compete successfully with gas for illuminating purposes, providing of course that corporations and other public bodies would use a sufficient quantity of it properly. He was opposed to doubtful experiments being instituted with the electric light; and as for Glasgow street lighting, he was confident that he would always get as much gas as he wanted, and that all the light that was required would be obtained from Glasgow gas. He went on to state that every reduction in the price of gas was turned to account by the Lighting Committee in allowing more gas for the public lighting. He was getting a benefit in this direction almost every year to the extent of from £1500 to £1600. The quantity of gas he was consuming in the streets, and on the common stairs within the city, amounted to upwards of 190 million cubic feet this year. He also made a few remarks on the undesirability of ceasing to recognize traders amongst the members of their Associations, as they were, he said, very much indebted to them—especially to the makers of meters and burners, who taught them how to develop the value of gas in consuming it. On the question of meter-rents, he considered that it would be better for gas companies and corporations, when they had any benefit to confer on gas consumers, to do so by reducing the price of gas, rather than by abolishing meter-rents.

One of the gentlemen present next asked if any information of a useful kind could be given to the meeting on the subject of water gas; and an interesting conversation arose out of the question.

Mr. M'Gilchrist remarked on the recent formation of companies in connection with the commodity referred to, and said that ordinary gas companies and corporations would take to the manufacture and use of water gas if it should be proved to be better than coal gas. Their policy, however, was a "waiting game." He referred to the use of water gas in America, where, he said, it had not proved to be very advantageous, inasmuch as it had, in cases of leakage, been highly dangerous to human life, as it was more insidious than coal gas, not having any smell.

Mr. MacPherson described the modes of enriching the water gas, and of using it to produce an incandescent light. As it was dangerous to employ it in its ordinary inodorous condition, it was frequently carburetted with hydrocarbon vapours, so as to impart an odour to it. But water gas had been known so far back as 1788; and there were no valid patents for its manufacture, either here or in America.

Mr. Hall, the Chairman, and some other speakers, made a few remarks on the subject. One of them stated that, from the information which had come to him from America, they had nothing to fear from it; while another said it was simply ordinary generator gas, and that gas companies were quite able to supply it, or a low-power coal gas which could be used with magnesia cones.

The question of meter-rents and of their abolition was the next matter on which discussion took place. Most of the speakers expressed themselves in favour of taking off the meter-rent; some of them giving their experience, which was generally very interesting. In certain cases, the meter-rent had either been wholly or partially removed, and along with it the price of gas had been reduced. Two speakers defended the levying of meter-rent—the matter being purely a financial one. A sufficient revenue must be raised in some way to meet all the expenses of a gas undertaking. Even the meters had to be maintained; and the consumers, it was urged, should bear part of the outlay involved.

Some conversation then took place on the policy of gas companies and corporations supplying gas-burners free to the consumers. Mr. M'Gilchrist, who opened the discussion, contended that as the consumers did not know the best burner to use to suit their circumstances, as to level above the gas-works, and in other respects, it was but right that they should be supplied with them free of charge. The other speakers generally agreed that such a policy was the correct one to pursue.

The discussion having been brought to a close,

Mr. MacPherson remarked on the absence of Mr. Mackenzie, and on its cause, which they all very greatly regretted. He moved a vote of condolence with him; and expressed the hope that his health would soon be restored. He also moved a resolution in

favour of Mr. Mackenzie being elected to preside over next year's informal meeting.

Mr. CARLOW seconded the motion, which was agreed to.

Mr. M'GILCHRIST then moved that their best thanks be given to Mr. M'Crae for presiding over the meeting in so able a manner; and in the course of his remarks he made a statement in reference to the visit which it was expected they would have been able to pay to the Govan Iron-Works, so as to inspect the remarkable plant erected there by Messrs. R. and J. Dempster for collecting and treating the blast-furnace gases for the recovery of the ammonia and tar they contain. He briefly referred to the nature of the plant; and expressed the hope that on the occasion of their meeting next year they would be able to visit the works.

Mr. M'CRAE suitably acknowledged the vote of thanks.

Subsequently the usual dinner was held in the large dining-hall of the Langham Hotel, which was fitted up with three "Lucient" generative gas-lamps. Mr. M'Crae (followed by Mr. M'Gilchrist) again presided; and the duties of the vice-chair were discharged by Mr. MacPherson.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

To-day we complete our summary of the proceedings at the annual meeting of the above Association, prepared from the Official Report, as published in the *American Gaslight Journal*.

Mr. C. F. PRICHARD, of Lynn (Mass.), read a report on the researches of Mr. Faber and himself, who were appointed at a previous meeting of the Association as a Committee to inquire into the subject of "Photometrical Standards." He commenced by referring to the need for a reliable photometrical standard in experiments on different kinds of lights, and said that although the average of a series of observations made with several different candles might be not far from the truth, it was now known that a single candle test was unreliable. Improvements were being made that afforded a comparatively small but still important increase in the quality of gas, and the value of such could not be accurately defined in the absence of a more reliable standard of light. By varying the heats, &c., the gas engineer could control the composition of his gas to a limited extent; but how was he to find out when the most advantageous results were obtained, without an accurate, and at the same time fairly rapid system of photometry. As illustrating the fact that the composition of gas could not be taken as an indication of the so-called photometrical value, he quoted the following three analyses, selected from the State Inspector's reports. If the analyses were correct, as there was every reason to believe, there was probably some error in the photometrical observations.

	I.		II.		III.
Illuminants	6·20	..	6·19	..	4·64
Marsh gas	36·98	..	35·77	..	35·97
Hydrogen	47 89	..	43·39	..	51·06
Carbonic oxide	7·56	..	6·70	..	7·02
Nitrogen, oxygen, and carbonic acid	1·37	..	1·95	..	1·59
Candle power	17·40	..	18·60	..	17·40

Some might regard this as a matter of the laboratory only; but he wished to insist that it was a very practical matter to manufacturers and sellers of gas, whether the State Inspector happened to return an 18-candle gas as 17, or on the other hand a 17-candle gas as 18 candles.

The following two conditions were necessary to secure an accurate standard:—(1) That the material which is burned should be one of practically unvarying composition, which is not affected in burning by wick or other apparatus. (2) That both material and device for burning should be simple and capable of duplication at any place or time. Only two of the proposed standards—the pentane and the amyl-acetate—conformed to this ideal. The Edgerton and Methven slots were simple and capable of exactly similar reproduction; but if the material used was common gas, it was liable to variation in composition. When the gas did not vary to the extent of more than one candle, they were useful and accurate. After describing the pentane lamp in its original and also improved form,* as manufactured by Messrs. Woodhouse and Rawson, attention was directed to some lengthy experiments carried out by Messrs. Pearson and Hathaway at the Institute of Technology, which comprised some 2500 observations. Operating with the older form of pentane lamp, two of them were compared together by placing one at each end of a photometer bar. The result of 400 observations showed an average difference of 1·05 per cent. in illuminating power, the greatest deviation being 1·57 per cent. Operating with the same amps, reversed, the average of 450 observations was 0·74 per cent., and the maximum 1·61 per cent. One of the lamps was then compared with a standard candle. The mean of 200 observations gave it a value of 1·073 as compared with the candle, and the greatest deviation was 2·77 per cent. The experiment was repeated with another candle, taking 200 observations as before, and the average result was 1·080, the greatest deviation being 1·38 per cent. The same lamp was next compared with the Methven screen. Taking 100 observations with the long slot, the result was a value of 2·136 for the Methven standard, and 100 observations with the short slot gave an average of 2·015. The greatest deviation was under 1 per cent. in each case. These experiments were repeated with the other pentane lamp, and showed a result of 1·857 with the long slot, and 1·924 with the short slot. The extent of deviation was less than in the first series. Attention was directed to the fact that the pentane standard is in excess of the standard candle.

The new make of lamp was compared with two different candles, and the average of 78 observations showed it to be equivalent to 1·11 candles. It was preferable to the old lamp, as giving a steadier light. Compared with the Methven, 40 readings were taken during an hour's test, and only three varied over 1 per cent. from the mean, which showed it to give a practically constant flame. The two forms of pentane lamp were compared one with the other by placing them at one end of a photometer bar, side by side, and completely screened from each other and the disc. At the other end of the bar was a Methven slot, against which they were compared with alternate readings, removing each screen alternately, and revolving the entire bar about the Methven as a pivot, until it was in line with each. The average results showed the new lamp to be a trifle—less than 1 per cent.—in excess of the other.

The pentane was obtained by treating ordinary gasoline with sulphuric acid and soda in order to purify it; and then distilling several times at 50° C. It was impossible to produce perfectly pure pentane by this process. He had seen samples having a specific gravity of ·626, ·629, ·632, ·636, and ·637. Mr. Harcourt stated that a liquid prepared as above, having a specific gravity ranging from ·628 to ·632 would always give constant results. The heaviest sample—that having a specific gravity of ·637—was compared with some sent from England, sp. gr. ·629, and found to affect the photometrical results to the extent of 4½ per cent. But it was not purified, and was the result of a first attempt at preparing it; and he thought it would be an easy matter for any chemist to produce a fluid conforming to the desired limit of specific gravity. Mr. Faber and himself recommended the new pentane lamp as more convenient and more accurate than the candle. No trimming or weighing were needed, and it could be adjusted as quickly.

A paper entitled "Breaking Coke" was read by Mr. F. C. SHERMAN, of New Haven (Conn.). He commenced by referring to the advisability of creating a home market for coke, by advertising it, and generally following the course adopted for pushing the sale of any commodity; and proceeded to describe an apparatus in use at his own works, consisting of a breaker and elevator driven by a 4-horse power steam-engine. The machine was so placed that the hopper was about 3 feet above ground level. From the breaker the coke passed to the endless link belt elevator, which lifted it a height of 15 feet to a screen set on an angle. The coke rolled down this screen, and the dust passed through into a compartment arranged to receive it. The object of elevating the coke was to enable it to spread out on the ground without requiring to be shovelled away. The machine would break all the coke that six men could shovel into it, and the cost, including building, was about £110. One hundred bushels of coke gave 85 bushels of broken coke, and 2 bushels of screenings. Last year 40 per cent. of his total coke sales was broken, and his price was 4d. per bushel for crude, and 5d. for the broken coke. He delivered a chaldron of broken coke weighing 1700 lbs. for 16s. 8d.; and the retail price of coal in his district was 21s. to 25s. per ton. The extra charge for the broken coke more than covered the cost of breaking, as well as the loss in measure.

Discussion having been invited, Mr. Nettleton said that he had adopted the plan of breaking coke, and developing a home trade, with such success that last year he never had more than a day or two's stock on hand, though his consumption of gas and consequent production of coke was rapidly increasing. He was able to get 4½d. per bushel on the works, for unbroken coke, and found that 200 bushels would produce 164 bushels of broken, which sold at 5½d. per bushel, and 9 of breeze which realized 2½d. per bushel. The extra price received just covered the cost of breaking and stacking. Mr. Cushing broke his coke by hand, with hammers, and considered this plan was much cheaper and more effective than machinery. Mr. Faber said that at Cleveland the coke was not touched by hand. It was run out from the retorts, quenched, taken by an elevator to a height of 50 feet, where it was broken and screened, and passed by gravity to store-bins for accommodating the different sizes. From these it could be allowed to fall into measuring bins, and then direct to the customers' carts, which were brought in under them.

Mr. R. J. MONKS, of Quincy, Mass., read an interesting paper on "Artistic Articles used in Connection with Artificial Lighting," illustrating his remarks by means of a collection of antique lamps. After this a paper on "Gas and Electricity," was read by Mr. S. G. STINESS, of Pawtucket, in which the combination of these two interests was strongly advocated.

*** Owing to the pressure on our space to-day, we are compelled to hold over till next week the concluding portion of Mr. F. J. Rowan's paper on "Flame" (see *ante*, p. 763), together with some interesting remarks by Mr. W. Foulis to which it gave rise.

MR. C. T. HAMER, foreman of the fitters' department of the Bark Street stores of the Bolton Corporation Water-Works, has been appointed Manager of the Batley Corporation Water-Works.

MR. A. ROSENFELD, of Bevis Marks, E.C., has joined the Board of Stapp's Water Gas Patents, Limited, after allotment. It is stated that applications have been received from numerous gas-works in various parts of the country for the adoption of Stapp's process. Applications have also been made for the whole of the foreign patents.

* The latter was described and illustrated in the JOURNAL, Vol. LI., p. 371.

Register of Patents.

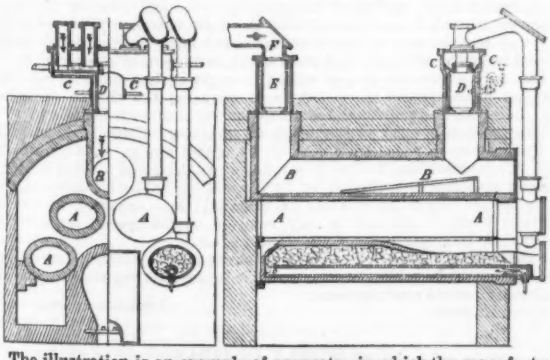
MANUFACTURE OF GAS.—Dinsmore, J. H. R., of Liverpool. No. 885; March 31, 1888. [8d.]

In view of the continued interest being manifested in the "Dinsmore Process," we purpose prefacing the description of the apparatus claimed by the patent now under notice with the somewhat extended remarks by which the inventor introduces his specification.

He says: The manufacture of gas to which this invention relates, has for its object to decompose all the volatile constituents of coal, by heat, within closed vessels; then, by afterwards subjecting them to heat, by passing them through heated ducts, to render all the volatile gases (heavy and light) permanent. The illuminating properties of the gas so produced contain, beyond the lighter volatile gases, those produced from the heavier and tarry vapours given off from the coal in distillation; and in this way, in respect of its illuminating properties and volume produced, considerably exceeds in quality that distilled in the usual manner and which is supplied to consumers. Now the object of this invention is the production of a gas which shall contain the gas produced from the heavier or tarry vapours as described, as well as those of a lighter nature, but in which the excess of illuminating power of the gas stated shall be diminished and replaced by an increase in volume. To this end the coal is distilled in retorts of any known suitable kind and afterwards the gas made is passed through a heated duct or ducts. By this means a larger volume of gas of a higher illuminating power is produced than is ordinarily supplied to consumers from gas-works. In a separate apparatus, hydrogen, "water gas," "producer gas," or like or equivalent gas is made and conveyed to and mixed with the distilled coal gas. This is done by preference either prior to its passage through the heated duct, or within such duct, as by this means a homogeneous mixture and better general result are obtained. The hydrogen, water gas, producer gas, or their equivalent, constitutes a diluent and is employed to effect an object afterwards explained.

The previous patents of the Dinsmore series—Nos. 7714 and 15,852 of 1887, and No. 2096 of 1888—have already been described in the JOURNAL; and in regard to them it is remarked in the present specification that, in the gases manufactured according to them, about 10,000 to 13,000 cubic feet of permanent or fixed gas can be produced from ordinary Yorkshire or equivalent coal, giving an illuminating power equivalent to from 20 to 25 candles. With this gas it is proposed to mix, as described, such a quantity of the diluent as to reduce the illuminating power (say) from 15 to 20 candles, by which its volume will be increased to from 15,000 to 18,000 cubic feet, more or less. When using other kinds of gas-making coal, the volumes and illuminating powers of the gas produced will, of course, vary; and therefore it may be necessary to add the diluent gas to the volume in different quantities or proportions. In all cases, however, it is preferred to introduce into the volatile gas such a quantity of the diluent as will give the bulk an illuminating power equal to about 15 to 20 candles.

Thus the gas according to this invention is composed of two main portions—one, the larger portion, being distilled from coal, which contains, besides the lighter volatile gases, those resulting from the distillation of the heavy or tarry vapours given off from the coal (such gas being made by passing the gas through a heated duct or ducts after distillation in the main retorts); and the other, the lesser portion, being the diluent gas, such as hydrogen, "water gas," "producer gas," or the like—both portions being rendered homogeneous. If hydrogen is the gas which it is desired to use as the illuminating diluent of the gas, it may be made by passing steam over highly-heated iron turnings, in closed heated vessels, such as a pipe or retort. The vessels containing the iron may be arranged in the bench of retorts and heated by the ordinary retort-furnace gases, or they may be placed in a special furnace and constitute a distinct appliance. When water gas is used as the illuminating diluent of the gas, the gas is made by passing steam through incandescent coke in a closed vessel—such as one of the retorts. The same remarks refer to producer gas when it is used as the diluent; only air, or air and steam, is used in lieu of the steam. When making water or producer gas, it is preferred to allow a portion of the gas to escape directly after charging the apparatus, in order that sulphur may be driven off from the coke, before any of the gas made is conveyed to, and intermixed with, the distilled coal gas.



The illustration is an example of apparatus in which the manufacture of gas according to this invention may be carried on. The details are described in patent No. 2026 of 1888.*

A are the existing retorts of a bench; B, a heated duct provided with vertical passages and an inclined shoot or gutter; C, a seal trough; and D E, cooled passages. In the retort A^1 water gas or hydrogen is made. The tar and ammoniacal liquor of the trough C is maintained at a constant level; while the cooling passage D is composed of walls leaving an annular space between them, in which the cooling fluid (preferably water) is circulated. This cooling space is extended under the bottom of the trough C; and the cooling fluid keeps the tar in this trough in a freely liquid state. The passage D is cool enough to prevent deposition of pitch or carbon therein. The cooled passage E, at the exit of the duct B, consists of outer and inner walls having between them an annular space. F is the outlet pipe on the end of this passage.

The operation of manufacturing gas in the apparatus is conducted as follows:—The coal is distilled in the retorts A in the ordinary way; the gas made in the apparatus passing into the common seal-trough C. Here it deposits a part of its tar and ammoniacal vapours. It then passes through the cooled passage D, wherein more tar and other vapours are arrested. The gas then passes through the hot duct B, and the whole of it is subjected to the heat thereof, whereby the greater part of the non-permanent portion of it is rendered permanent. The gas is then passed through, and subjected to the cooling influence of the cooled passage E; and a portion of the tarry or non-permanent vapours still existing in the gas are condensed and arrested. The tar condensed in the passages E and D, and the trough C, and the returned tar, as hereafter described, fall into the duct B; and, in presence of freshly distilled gas from the retort A, are converted into gas. The ammoniacal liquors condensed in the trough C are, however, drained away by a pipe placed at such a height in the trough as to do this, but so as to leave the heavier liquid—the tar. When the tar in the trough C rises up to slightly above the level of the lip of the pipe, it falls directly on to the highly-heated surface of the bottom of the duct B, or on to the red-hot surface of any medium placed therein. The matters condensed in the passage D fall directly on the bottom of the duct B. The retort and duct are preferably heated and worked at a temperature denoted by a clear cherry-red colour—known in gas making as a medium temperature. The tar condensed from the gas after leaving the apparatus, is brought back, by gravity or otherwise, and introduced into the seal trough C, whence it falls into the hot duct B, and is gasified; or it may be introduced into the duct by the pipe shown in dotted lines in fig. 1.

The gas resulting from the process of manufacture thus far definitely described would, says the patentee, if made from ordinary bituminous gas-making coal, such as that known as Lancashire or Yorkshire coal—not cannel—possess an illuminating power equal to about 24 candles; and the volume of permanent or fixed gas produced per ton of coal, would be from about 12,000 to 13,000 cubic feet. This quality of gas is higher than is now desired by most gas manufacturers; so the proposal is "to turn to that which is more a desideratum to most gas makers—namely, an increase of volume per unit of coal." This the patentee purposes doing, as already stated, by admixing hydrogen, water gas, or other diluent gas with the coal gas, to such an extent as to reduce its illuminative quality to that required. If the quality of gas required be equal to (say) 17 candles, the volume will be increased to about 17,000 cubic feet. Thus the quantity of water gas added would be 4000 cubic feet.

In the apparatus illustrated, one of the retorts, A^1, is employed to produce the water gas or hydrogen. The operation is as follows:—The retort is filled with coke, and steam admitted. It passes to the end of the retort, thereby becoming superheated, and then travels back through the incandescent coke to the mouth of the retort, and so on up to the ascension-pipe and dip-pipes into the trough C. Here the water gas produced joins with the coal gas coming from the retorts A; and in passing together through the passages and the duct B, they become intimately mixed, fixed, and blended. In passing through the coke, the oxygen of the steam combines with the carbon of the coke (becoming carbonic oxide); the hydrogen being thereby liberated.

* See JOURNAL for April 16, pp. 714-15.

GAS AND OTHER ENGINES.—Tavernier, A.E., of Hitchin, and Casper, E., of Bayswater, London. No. 5628; April 16, 1888. [8d.]

This invention chiefly relates to engines of the class described in patent No. 4757 of 1887, in which motion is produced partly by the explosion of an inflammable mixture and partly by steam generated from water introduced into the cylinder to cool the same; the claim being for the employment in an engine operated by the explosion of an inflammable mixture in combination with the power cylinder, of a chamber or chambers in which the ignition of the inflammable mixture is effected, and having arranged in connection with them means for introducing pure gas or vapour to enrich the mixture therein.

GAS-ENGINES.—Gaze, E. H., of Walterton Road, London. No. 6036 April 23, 1888. [11d.]

This invention relates to gas-engines, particularly those using explosive charges of air and gas in a compressed state. It has for its objects the construction of engines capable of starting by the energy supplied at and during admission of their ordinary working charges, causing initial propulsion aided by great frequency and continuity of impulse. This effects economy by the reduction of the axial length of charges used, and using a greater ratio of expansion before exhaust than is possible where compression takes place in the motor cylinder. The patentee also claims that he obtains a second impulse in the same stroke by the explosion of the charges after initial propulsion, so as to use the greatest heat of the explosion while the piston is moving at its greatest velocity, to diminish the loss of heat to the cylinder by diminishing the time of contact to the ratio of work done; also the abolition of negative work in the motor cylinder, and causing all heat received by the charges after admission to the motor cylinder to be expended in favour of the engine, and obtaining greater power without increasing the size of motor, by reason of more frequent impulses.

DRILLING AND TAPPING WATER, GAS, AND OTHER MAINS UNDER PRESSURE.—Turner, G. H., of Folkestone. No. 6750; May 5, 1888. [8d.]

This invention, relating to apparatus for drilling and tapping holes in mains under pressure, has for its object to prevent the waste which takes place when the operation is performed in the usual manner. A further advantage is that it is not necessary to cut off the main supply during the operation of drilling and tapping holes for the purpose of inserting branch-pipes.

The invention consists essentially of a rectangular box provided upon its underside with projecting lugs, by means of which it may be firmly clamped to the main or pipe to be operated upon. The top of the box is adjustable, and is arranged to slide in guides formed in the sides of the

box, and which guides are rendered water-tight by their form of construction. Upon the adjustable top of the box is a stuffing-box having three glands, through which pass respectively a drill mandril, tap mandril, and ferrule mandril. The bottom of the box has an aperture through which the drill tap and ferrule may be extended into the main or pipe in turn. In order to facilitate the adjustment of the top of the box, a hand-wheel and screw is fitted to the side of the box; and by this means the drill, tap, and ferrule may be adjusted to coincide with the aperture in the bottom of the box, as required. A suitable washer is placed in a recess around the aperture in the bottom of the box, to make a water-tight joint when the main and box are clamped together. The front, side, and back of the box have a small aperture filled in with glass, in order to inspect the working of the drill or tap. The drill and tap are conveniently operated by a ratchet or other brace placed in succession upon the drill and tap, and centred against a suitable swinging arm pivoted to both sides of the box.

GAS-HEATERS.—Speilmann, I., of Westbourne Crescent, London, W. No. 7469; May 19, 1888. [8d.]

This is a modification of the apparatus described in patent No. 1509 of 1885—a gas-heater having a kind of Bunsen burner supported by a spring, and connected to a gas-valve in such a manner that the supply is given only when the weight of a pan or other vessel resting on the burner presses it down in opposition to the spring, and thus opens the valve, allowing gas to pass to the burner. On removing the pan or other vessel, the valve for the supply of gas to the burner is automatically closed; but a bye-pass is opened, supplying a small jet which remains ready to ignite the main burner when it is again required.

The present invention relates to a more compact and simple construction of heater arranged to act in the way above described. In this heater the gas is supplied at the lower part immediately under a spring-valve, the stem of which extends upwards a little above the level of three brackets, on which the vessel to be heated is placed; part of the weight of the vessel when it is so placed pressing down the valve-stem, and so opening the valve. The gas passing the opened valve issues in a jet directed horizontally along a tube under the burner; the tube having lateral holes by which air is drawn in to mix with the gas. The mixture of air and gas ascends from the horizontal tube into a space above (preferably circular), which is covered with wire gauze to ensure a more thorough mixture and distribution of the gas and air, and to prevent the flame from striking back. Above the gauze there is a cover, having through it a number of holes arranged in rows, through which the mixture issues so as to form a number of flames immediately under the vessel to be heated, while air is free to pass between the rows and supply these flames. On removing the vessel, the stem of the gas-supply valve being free to rise, the valve is closed by the spring, and the main burner is extinguished. But, the stem of the valve being tubular, gas finds its way through it—entering at the bottom of the stem—and issues from a small lateral hole in a jet immediately above the main burner, ready to ignite it when required.

GAS-PRESSURE REGULATORS.—Fletcher, W. F., of Birmingham. No. 2599; Feb. 14, 1889. [11d.]

One of these improvements consists in regulating the pressure of the ascending stream of gas after it has passed through the valve, which is effected by means of a regulating-screw placed in the governor so as to open or close the passage leading from the regulating-valve. Another of the improvements consists in the peculiar construction of the regulating-valve, and in the arrangement of the passages and parts of the governor for an ascending current.

APPLICATIONS FOR LETTERS PATENT.

6392.—WRIGHT, F., "Improvements in apparatus for the automatic regulation of the pressure given by station gas-governors." April 15.

6431.—VALON, W. A., "Improvements in stop indices for prepayment gas-meters." April 15.

6432.—SANDERS, F., "Improvements in retorts for producing gas." April 15.

6437.—CREWE, H. T., "Means and appliances for automatically closing the passages of gas-mains and supply-pipes in cases of fire, specially applicable to the bags of gas-engines." April 15.

6445.—CLARKE, T. E., "Improvements in gas-stoves for heating and cookingp urposes." April 15.

6510.—MILLER, R., "Valves for gas and air furnaces." April 16.

6567.—DEIGHTON, W., "Improvements in gas-producer apparatus, and appliances connected therewith for the manufacture of water gas and other gases." April 17.

6605.—BROPHY, M. M., "Improvements in gas-grilling apparatus." April 17.

6613.—WYNGAERT, F. VAN DEN, "Improvements relating to gas-burners." April 17.

6659.—LANGER, J. VON, and COOPER, L., "Improvements in or connected with the manufacture of water gas." April 18.

6660.—LYON, J. H., "An improved socket or coupler for connecting suction or other tubes to gas-main syphon-boxes and for other purposes." April 18.

6683.—AITKEN, H., "Improvements in treating bituminous, carbonaceous, or combustible substances to obtain gas and other products, and in the treatment of gases such as result therefrom. April 19.

6700.—FLETCHER, T., and CLARE, A., "Improvements in and relating to gas-fires." April 20.

6712.—LEES, F. S., "An improved gas-valve." April 20.

6737.—DELAMARRE, H. M. H., "Improvements in regenerative gas-lamps for lighting railway and other carriages." April 20.

6738.—WALLWORK, R., and WELLS, A. C., "Improvements in or applicable to self-generating gas or vapour burners for lighting and heating purposes." April 20.

6747.—BLISS, W., BRADBURY, E., and GIBSON, A. H., "Improvements in and connected with burning gas tar or other liquid fuel in steam-boiler and other furnaces." April 20.

Correspondence.

[We are not responsible for the opinions expressed by Correspondents.]

DEBENTURE STOCK.

SIR,—In the JOURNAL of the 9th and 16th inst. (pp. 675, 725), there are reports on the proceedings of a gas company respecting the raising of debenture stock, about which, to judge from the report, there seems to be some difficulty; and as the raising of debenture stock is one of the most ordinary transactions of a gas company, for which everything is pre-arranged, I fear there must be some misunderstanding about it, and shall therefore feel obliged if you will permit me to say a word or two on the subject in your next publication.

The report on the 9th inst. stated that a general meeting of the shareholders was summoned to consider a special resolution to authorize the directors to create debenture stock, &c., and that, if the resolution was passed, it was to be added to the Articles of Association. As Articles of Association belong exclusively to limited companies, and limited companies cannot create debenture stock, this statement is somewhat confusing. But even if the company are duly authorized, it may be useful to state that there is no law to authorize companies generally to create debenture stock; no company can do so without taking special parliamentary powers for the purpose. The Companies Clauses Act, 1863 (which is always incorporated in the Special Act when these powers are granted), provides all the regulations necessary for, and incident to, the creation of debenture stock; and no company can go beyond, or stop short of these.

The Act of 1863 specially gives power to companies, when they have created bonds and mortgages to the full amount authorized, to create debenture stock in excess of that amount to redeem the bonds and mortgages when they fall due, either in one large sum and all at once, or in sundry small sums from time to time, as the case may require, so as to avoid the expense of brokers, agents, financiers, and the like. It is not necessary to wait for the bonds falling due. They can be exchanged at any time; and many are redeemed long before they arrive at maturity.

In practice, it is found that when the bondholders are offered debenture stock in exchange for their bonds, if there is no great difference in the terms, the bonds are in almost all cases preferred to cash, and the exchange made without trouble or expense.

Bearing in mind the direction in which gas legislation is now tending—that is, to raise all new capital on the lowest possible terms, and the obvious advantage that it is to a company to do so—debenture stock, if not distributed among the shareholders, ought to be sold by auction. In the former case, it only benefits those who are in a position to advance money on loan, while in the latter it to some extent benefits all the shareholders alike.

W. LIVESEY.

Gas Companies' Association, Palace Chambers, Westminster, April 20, 1889.

GAS AND ELECTRIC LIGHT IN PARIS.

SIR,—The report for 1888 of the Paris Gas Company just published gives strong proof that the Directors of that great undertaking, employing about 3½ millions sterling of capital, are not much disheartened by the prospects of electric lighting in Paris. It appears that during the year 1888 they laid out additional capital of £145,000 at one of their stations—Le Landy—and on their six stations no less than £320,000, or not far from 10 per cent. on their gross capital. This is equivalent to an outlay on new plant in London of £1,500,000.

This is the more remarkable when we remember the high price of gas in Paris—an evil caused in a great measure by the enormous contribution which the Company pay to the municipal taxes of Paris—a charge which last year amounted to £542,000, or something like 35 per cent. of the dividend paid by the Company.

If such be the view taken by the Paris Company, who charge a price equal to about 6s. per 1000 cubic feet for gas, I do not think that London Companies, who charge only about one-third of this price, need be very apprehensive of the competition of the "light of the (remote) future."

DENNY LANE.

Cork, April 18, 1889.

GASHOLDER CUPS.

SIR,—I have read with much interest the discussion on the best form of gasholder cups; and after weighing the *pros* and *cons.* of the two forms mentioned, I must confess that the channel-iron cups have not in any way lost ground by the discussion, but have without doubt been proved to be the strongest and most convenient form of construction.

The only argument of any weight brought against channel cups, is that the greater length of riveted joints increases the chance of leakage; but even this point has been ably met by your correspondents.

The question of corrosion is purely an imaginary difficulty, because it is just as easy to put thick plates for a channel cup as for a bent-plate cup. Experience has decided how much extra thickness to allow for corrosion; and this is reckoned for by the best gasholder builders. Anything beyond this is mere waste of material; and anything less is a mistake in the design, and is only resorted to (for special reasons) by indifferent designers and makers of gasholders.

"Designer's" letter in last week's JOURNAL adds nothing new to the discussion; in fact, his statements are so loose, that the merest tyro in engineering could confute them.

ANOTHER DESIGNER.

April 27, 1889.

GAS SUPPLY IN JAPAN.

SIR,—In your issue of the 22nd of January, last a further letter appeared under the above heading, from your correspondent Mr. Ross. Mr. Ross seems to think that gold, silver, and paper yens are of the same value. He says: "The Japanese yen (gold, silver, or paper) is current value for 100 cents in Japan;" and adds that "the 5-yen gold coin . . . circulates in the country at 500 cents." Allow me again to correct Mr. Ross. A gold yen is worth 134 cents; and a 5-yen gold coin is worth 670 cents. In other words, gold money is at a premium of 34 per cent.

But why does Mr. Ross speak about gold money? It is not now in

circulation in Japan. Gas accounts are not paid in gold. If a consumer uses 1000 cubic feet of gas, he pays the gas company 2 yen 70 cents in silver or in paper money. When Mr. Ross resided in Japan, gold and silver yen were of equal value, and were equivalent to 4s. 2d. English money. The value of Japanese money has entirely changed since then. Gold yen are not in common circulation; and the silver yen is worth only 3s. 2d. English money. In converting Japanese money into English money, Mr. Ross has based his calculation on the rate of exchange at the time of his residence in Japan (some ten or twelve years since, I believe), instead of the current rate of exchange. The price of gas instead of being 11s. 3d., is only 8s. 7d. per 1000 cubic feet. Mr. Ross says: "The rate of exchange has nothing to do with the sale of gas in Japan." But if we wish to convert the price of gas in Japanese money into English money, we must make the rate of exchange the basis of our calculations. Mr. Ross is also wrong in saying that, "being a native company, they have no occasion to convert their money into English in the production of gas." All the materials used in a gas-works (with the exception of coal and oxide) must be obtained from England, and, together with the assistance of foreign *employés*, must be paid for in English money.

I should like to add that, in writing this letter, I am not attempting to defend the price of gas in Japan. I am quite aware that gas can, and ought to be supplied at a much lower rate than it is at present; and I hope to be able to announce in a short time that the Tokio Gas Company have made a further and substantial reduction in the price of gas.

I must apologize for asking you to insert a letter the contents of which are of little interest to the majority of your readers.

Gas-Works, Tokio, Japan, March 19, 1889. WM. NEWBIGGING.

THE "LUCIENT" REGENERATIVE GAS-LAMPS.

SIR,—My attention has been directed to a paragraph in your issue of the 2nd inst., relating to the results of my tests of these lamps, which is of a decidedly misleading character; and I am consequently compelled to request the insertion, as early as possible, of this letter, in order to put matters right.

In that paragraph, the following words are used:—"Although the illuminating power was increased from 4·50 to 17·88 candles per cubic foot of gas burnt, it was believed that this was not the highest possible yield, as, in order to make a test, the consumption had to be reduced to far below the working capacity of the lamp." Now, this statement is quite correct, provided it is understood on all sides that it does not apply to the testing of the lamps at the usual angle of 45°, but only to exceptional angles and to the "vertical." At the angle of 45° the tests made were perfect in every respect, and both the apparatus and testing-house were also as perfect and as efficient as any in the United Kingdom; and I cannot have it for a moment supposed, as your paragraph implies, that either the photometer or the testing chamber was in any respect whatever defective or inadequate for testing any known lamp under the ordinary conditions. I think, in fairness to other lamps as well as to this one, you ought to state the actual results obtained at the usual angle of 45°, and which, as I have already said, were perfect in every respect, and were not obtained under any disadvantageous circumstances whatever.

ROBERT R. TATLOCK.

City Analyst's Laboratory, Glasgow, April 24, 1889.

COUNTY AUTHORITIES AND THE LAYING OF MAINS ON BRIDGES.

SIR,—In reply to your correspondent "A.B.H.," whose letter appeared last Tuesday, I beg to state that the error was di-covered when the letter was in print, and was purposely left open this week for discussion. The main is actually 7 inches in diameter, and, if required, it was impossible to lay the two smaller pipes larger than 5-inch—in fact, these mains are barely out of sight; but, the water being in motion, we have had no trouble through frost.

I am obliged to "A.B.H." for pointing out the error; but I am sure your readers would have been greatly interested if he had given his experience on the very important subject, and helped to solve the problem which is now being discussed for the second time in the JOURNAL.

I hope to read in your next issue "A.B.H.'s" opinion on the right of laying mains over bridges.

MAIN LAYER.

April 26, 1889.

THE PROVISION OF FITTINGS BY SUPPLIERS OF GAS.

SIR,—In reading Mr. Valon's letter on the above question, and your remarks thereon, published in January last, it at once struck me that the weak part in the proposed scheme was the want of a cheap prepayment meter; so I at once, in a letter dated Jan. 26, 1889, wrote Mr. Valon as follows:—

"With regard to your suggestions, it appears that the chief question is that of meters. Most of the tenants you propose to supply let apartments, and in some cases the whole house, so would naturally be anxious to avoid waste, and be repaid for the gas supplied. Many persons are habitually wasteful, especially with other people's property. Are the prepayment meters expensive? If not, they would seem to meet the difficulty, as a tenant might supply 1000 cubic feet of gas as he or she would so many candles or coals to lodgers. In such houses the boiling-ring would be a very important feature, as the bulk of such visitors would appreciate a ready arrangement for getting a little boiling water for a shave or a cup of tea; for warming baby's food during the night or day; for cooking a steak or a chop, or preparing other meals without bothering the landlady. Such a convenience in a small house would, I think, prove a great attraction to a large number of visitors of limited means, who would give a preference to houses supplied with gas for such purposes; but such persons, although not objecting to pay for the convenience, would like to know they were not being *charged in excess.*"

The importance of providing a cheap prepayment meter was thus very fully enforced. In your article in the JOURNAL for April 23, you rightly say: "Matters are greatly simplified by the prepayment meter, which was not mentioned in Mr. Valon's letter; and it is to be hoped that the Corporation, the consumers, and the Engineer will reap the full benefit from this praiseworthy piece of enterprise." In the same article you further remark that the "fundamental proposition" of the Ramsgate Corporation was "qualified and explained by a series of supplementary recommendations which served, among other purposes, to introduce a prepayment meter. Mr. Valon has invented a meter of this class, which, not in his own opinion only, fulfils all practical requirements better than any other of the same order that has yet been put upon the market." Then, again, you observe that "the appearance on the scene of this prepayment meter has made a great difference in the aspect of the whole scheme; removing, in fact, the element of risk which it originally contained. As now settled by the Corporation, the use of the prepayment meter is compulsory." Although prevented from being present at the last meeting of the Ramsgate Council, I, at the previous meeting, held on March 19, drew attention to the fact that no reference had been made in the Engineer's report to the proposal to supply fittings to a certain class of houses; and I urged the Council to give the matter their early consideration. I also again pointed out the desirability of supplying prepayment meters to such consumers. So much importance did I attach to these matters that, not having received a reply from Mr. Valon to my letter of Jan. 26, and thinking, therefore, that there was no suitable prepayment meter in the market, I went to some considerable trouble with a view of supplying one. It appears, however, that Mr. Valon has now done this, and taken out a patent for the same.

W. VINCENT GREEN.

Ramsgate, April 26, 1889.

THE EARLY DAYS OF THE GAS INDUSTRY IN LONDON.

SIR,—The other day I met with an old book, called the "Hundred Wonders of the World," published in 1818, in which mention is made of the gas industry. Consequently, I presume that lighting by gas was then regarded as one of the "wonders." It is there stated that Mr. Brande had found by experiments at the Royal Institution "that a chaldron of good Wallsend Newcastle coals would afford from 17,000 to 20,000 cubic feet of gas; but the process of distillation, as it had been carried on in the large establishments for lighting the Metropolis, had seldom afforded a larger average produce than 12,000 cubic feet." It is further stated as follows:—

"In the month of April, 1816, at the three stations belonging to the Chartered Gaslight Company, situated in Peter Street, Westminster, in Worship Street, and in Norton Folgate, 25 chaldrons of coals were daily carbonized, actually yielding 300,000 cubical feet of gas, equal to the supply of 75,000 of Argand's lamps, each lamp giving the light of six wax-candles. If the full proportion of gas had been obtained—namely, 20,000 cubic feet—from each chaldron of coal, the produce would have been 500,000 cubic feet, equal to the supply of 125,000 lamps of the same size; and the light then afforded would have equalled that of 750,000 wax-candles, instead of 450,000, which was the real produce. Including that of the City Gas-Works, in Dorset Street, Blackfriars Bridge, the total daily consumption of coals in London, for the purpose of illumination, then amounted to 28 chaldrons, and the number of lights supplied to 76,500; but this amount has been since greatly augmented, and this invaluable discovery . . . is rapidly communicating its benefits to every part of the United Kingdom."

W. MANN.

April 25, 1889.

WATER BY MEASURE.

SIR,—In the JOURNAL last week, "Consumer" refers, with doubtful taste, to what he calls my "pet low-pressure meter," of which he further expresses ignorance by speaking of "this particular meter whatever it may be." He, however, goes on to say that it is a "delicate machine which, in my opinion, will require frequent inspection and adjustment," which suggests that his ignorance of the nature of the meter is merely affected, and yet proves that his knowledge of the meter itself is extremely small. There would be no good purpose served by arguing with him, more especially as he says he is opposed to "the meter system in any form." I may, however, just remind him that he ought not to forget the amenities of controversy.

Between "Positive" and myself, there are one or two questions it is desirable to "clear up"—notwitstanding his avowal of opposition to the supply of water by meter. It was he who first challenged a comparison between the existing system of placing *gas*-meters "at the end of the service," and that of fixing *water*-meters at the *beginning* of it. In a former letter he said that "gas men" would not fix their meters "at the end of the service;" but he was shown that this was the very thing they usually did. He has delayed his reply till now, and informs us that, by "the end of the service," he "means that point where the company's responsibility ends; and this is at the boundary wall of the property." Now! I agree with him that "the end of the service is where the company's responsibility ends;" but I deny that, in the case of gas (and it was of gas he was speaking), this is at "the boundary wall of the property." For it is not *there*, but *inside the building* to be supplied, that the gas-meter is usually placed; and this, I contend, is also the proper position for the water-meter. But having got the length of placing the water-meter *within the building*, the question of its efficiency as a measurer comes up for consideration.

It used to be, and still is, urged as an objection to water-meters, that they could not be depended upon to measure all the water delivered into cisterns. The "bottom" was knocked out of *this* argument, by the production of the meter which you described on Dec. 4, 1888. The existence of this meter has materially changed the conditions of the controversy—as may be seen in the case of writers like "Positive." These seem to think it safer to object to meters altogether; but if there *must* be meters, they prefer those which are open to the old objection, and are therefore less difficult to exclude when the question is the measurement of water *for domestic purposes*. Whether or not the course followed be a generous, or even a fair one, I must leave you and your readers to decide.

The mere fact that the water-service is "the property of the consumer" is no sufficient reason for placing the meter at its beginning in cases where the end of the service-pipe delivers the water into a cistern. Surely it would be more rational, in this case, to use the form of meter best adapted for the measurement into a cistern, than to use a kind of meter universally admitted to be unreliable under such circumstances. Even although the service is "the property of the consumer" the company will never be indifferent to its soundness; and although gas companies usually own the service-pipes, this is not the chief reason for placing the meter within the building. Surely the same measures which prevent leakage from *gas*-services would be effective to prevent leakage from water-services; and it is not unreasonable to suggest that the water company would gain more with a low-pressure

meter at the cistern—*measuring every drop of water*—than they could conceivably lose by the *contingency* of a leak in the service-pipe. In any case, they would be no worse off than gas companies; and it is impossible to see what right they have to be any better. If water companies were not so averse to the use of water-meters, such arguments as have been used against them by "Positive" and others would speedily collapse. The truth is, that *the low-pressure system has never been fairly considered*, because there has not been any real desire on the part of water authorities to use water-meters. There are signs of this feeling giving way; and it is certain that, if ever water-meters become general, for domestic purposes, it will be the low-pressure system that will be adopted.

I decline now, as I have declined before, to be "drawn" into any discussion in regard to "the cost to be entailed on the City of London and on the consumers by the adoption" of a meter system. The question at issue is not this; and I prefer to confine my attention to the point. I would just remark, however, that considerations of this kind were powerless to prevent the introduction of gas-meters into general use; and they would be equally powerless to stay the progress of the demand for water-meters, but for the so-called "sanitary" reasons by which they are supported. Clearer views and stern necessities will sooner or later prevail, and compel the use of water-meters to a much greater extent than "Positive" is disposed to think possible.

April 25, 1889. LOW PRESSURE.

WATER GAS.

SIR,—I enclose you herewith copy of a letter from Mr. B. H. Thwaite, which was published in last week's *Engineering* (in answer to my letter on the above subject which appeared in the previous issue of that paper, as well as in the JOURNAL for the 16th inst.), and my reply to the same.

London, April 23, 1889. GAS.

[ENCLOSURES.]

To the Editor of *Engineering*.

Sir,—In reply to your correspondent "Gas," in my calculations I referred to ordinary producer gas. I do not understand, in chemical parlance, what is meant by Siemens gas. Perhaps your correspondent had an object in specifying it by name, and in adopting a *nom de plume*? Nevertheless, his remarks are sensible and to the point, and confirm, in his own way of adapting my calculations, my contention that the absence of nitrogen in water gas is not always an advantage. Your correspondent refers to a prior correspondence on the subject, in which it was shown that the application of water gas for steel-melting is weighted with a serious financial disadvantage. Whether in actual practice a financial loss is incurred in the particular instance referred to in the correspondence, I know not; but if we compare the relative thermic efficiencies for steel-melting applications—when using water gas and producer gas—we shall find that it confirms what I have always insisted on—viz., that for applications requiring high temperatures, the higher the thermic value of a gas the greater the actual useful efficiency. Of course, this does not necessarily mean a financial saving; but it is a most important step towards such a desideratum.

At one iron-works in Austria, it is stated that 22,000 cubic feet of water gas are required per ton of steel ingots; this is equivalent to an expenditure of 7,392,000 British units. Now the best practice in a modern open-hearth (Siemens) recuperative steel furnace, using producer gas, is about 9 cwt. of fuel to the ton of steel ingots; equal to 1708 lbs. of fuel, and equivalent to an expenditure of 14,400,000 British units. So that we see the use of water gas in this application reduced the number of units by about 50 per cent. The explanation is easily found. It can be shown that the thermic loss in high-temperature furnaces, by radiation and convection, is very serious; and this loss is reduced by the acceleration of the process which follows the application of an agent of a higher thermic value. In the hearth of a reverberatory furnace having (say) 40 cubic feet, the value of the heat units in volumes of producer and of water gas would be more than three to one in favour of water gas—that is, on the basis of equal volumes of the two gases passing through the furnace at equal periodic rates. This higher thermic volumetric value means a greater output from furnaces, and *pari passu* reduction in loss of heat by convection and radiation, less loss by oxidation of ferro-manganese, less cost of labour, greater efficiency of plant in proportion to its value, and less cost of official supervision and official administration per unit of output. Then there is the advantage of immunity from sulphur possessed by water gas.

The weak place in the application of water gas is touched by your correspondent in the fact that its production is intermittent. We see that in a ton of coal, out of its 32,000,000 British units, only some 11,700,060 are absorbed by the water gas; the balance, less the unavoidable loss by radiation, &c., is appropriated by the producer gas, and has to be utilized or lost.

In a large metallurgic works there is no difficulty in utilizing the ordinary producer gas for steam generation, reheating, soaking, ladle drying, &c.; but in works of less magnitude and complexity, it might be difficult to find appropriate uses for this gas, and in such instances the margin of advantage in favour of the use of water gas might be reduced to a shadowy figure.—Yours truly,

B. H. THWAITE.

37, *Victoria Street, Liverpool, April* 13, 1889.

To the Editor of *Engineering*.

Sir,—In reply to Mr. Thwaite's letter in your issue of the 19th inst., I may say that I simply followed his calculations, in which there was no question of Siemens or any other producer gas. Mr. Thwaite referred to absolutely pure carbonic oxide gas made from perfectly pure carbon; and in my previous letter I corrected a clerical error in the chemical equations relating to such gas given in Mr. Thwaite's letter of the 5th inst. Mr. Thwaite said, "Let $2N_4O + C = 8N + CO_2$ and $8N + CO_2 + C = 8N + 2CO$. Then the combustion would be effected as follows:—$8N + 2CO + 2O + 4N = 12N + CO_2$." The mistake made was in the proportion of nitrogen; and the equation should be $2(CO + 4N) + 2(O + 4N) = 16N + CO_2$. Again, taking the combustion of such gas for 12 grams of carbon, and a temperature of 500° C. in the chimney, he gave the following equation:—

$$500\left[\frac{CO_2}{(12+32\times0{\cdot}217)+(64\times0{\cdot}244)}\right]^{N} = 15{,}222 \text{ units lost,}$$

which should be

$$500\left[\frac{CO_2}{(12+32\times0{\cdot}217)+(112\times0{\cdot}244)}\right]^{8N} = 18{,}438 \text{ units lost,}$$

I then proceeded to show that, taking Mr. Thwaite's figures, water gas was only 0·5 per cent. better than the producer gas referred to, which is equivalent to a saving of 10 cwt. per 100 tons of fuel consumed in the regenerative gas-furnace.

But I might have taken 370°—700° Fah. (see p. 385, Vol. I. of the collected works of Sir William Siemens) as the chimney temperature. The loss by the use of water gas would then be—

$$\begin{aligned} 45{\cdot}534 \times 370 &= 16{,}847 \text{ units sensible heat} \\ 18 \times 606{\cdot}5 &= 10{,}917 \text{ latent heat of steam} \\ &\overline{\quad\quad} \\ &27{,}764 \text{ units of heat lost;} \end{aligned}$$

whilst by using producer gas there would be only—

$36{\cdot}876 \times 370 = 13{,}644$ units lost; or in the first case

$$\frac{27{,}764 \times 100}{125{,}208} = 22{\cdot}17 \text{ per cent. loss,}$$

and in the second case

$$\frac{13{,}644 \times 100}{67{,}284} = 20{\cdot}27 \text{ per cent. loss,}$$

or a slight saving of about 2 per cent. in favour of producer gas as compared with water gas.

I cannot help thinking, however, that a more practical way of testing the efficiency of an industrial appliance is the work done. In my last letter, I drew attention to a letter published by you on the 10th of August last, in which it was clearly shown, from figures supplied by water-gas authorities, that, to melt steel on the open hearth with water gas, it would cost 74 per cent. more for fuel than with Siemens gas, burnt in a properly-designed regenerative gas-furnace. In that letter it was assumed, from data given by Mr. Wilson in his paper read before the Iron and Steel Institute in the spring of last year, that "17,500 cubic feet of water gas were required to melt a ton of steel on the open hearth." If 22,000 cubic feet are required (the number given by Mr. Thwaite in his letter under reply), the cost of doing the work with water gas will be cent. per cent. dearer than with Siemens producer gas.

I may say that it is quite requisite to distinguish the gas made in the Siemens producer for a definite purpose from the waste product made in the water-gas converter, honoured with the title of producer gas in the reports of the Water Gas Syndicate, and accepted under that title by Mr. Thwaite. This water-gas apparatus has been designed to produce during a third of the time it is employed, heating gas of high calorific value; whilst during two-thirds of the time it is used, it is producing what is practically a waste product. The Siemens producer was designed with the object of making heating gas without any waste product whatever; this gas to be used in the regenerative gas-furnace—a furnace in which the highest temperatures required in the arts have been produced with facility for the past twenty years.

At the close of his letter, Mr. Thwaite remarks that of 32,000,000 British thermal units contained in a ton of coal, only 11,760,000 are absorbed by water gas; the rest must be utilized in some other way or lost. At p. 220, Vol. I. of Sir William Siemens's Works already referred to, is the following analysis by volume of gas made in 1865 at St. Gobain, and used in the regenerative gas-furnace—viz., CO 23·7 per cent., H 8 per cent., and hydrocarbons 2·2 per cent.; 170,000 cubic feet of such gas being produced per ton of coal.

	Per Cent.	Sp. Gr.		B.T.U.	
CO	= 23·7	× ·078	×	4,330	= 8,004
H	= 8·0	× ·00559	×	53,000	= 2,370
Hydrocarbons	= 2·2	× ·04	×	22,000	= 1,936
					12,310

per 100 cubic feet, or 20,927,000 British thermal units out of 32,000,000 given by Mr. Thwaite.

By means, however, of the Siemens improved apparatus introduced in 1883, a gas of much higher calorific power has been obtained of the following composition:—

	Per Cent.	Sp. Gr.		B.T.U.	
CO	= 26·6	× ·078	×	4,330	= 8,914
H	= 11·0	× ·00559	×	53,000	= 3,259
Hydrocarbons	= 4·0	× ·04	×	22,000	= 3,520
					15,763

per 100 cubic feet, or 26,797,100 British thermal units per ton of coal, or an efficiency of 84 per cent., assuming 32,000,000 units per ton, instead of an efficiency of 37 per cent. in the case of water gas. In cases of this kind, however, there is not much use in comparing actual results with average possibilities. At St. Gobain the coal was probably not equal to 32,000,000 units per ton; and in the case just given, it was probably above that average.

Water gas burns with a transparent blue flame, which must be carburized, as in America, to produce a luminous flame, or it must be used to render some solid body incandescent, and then, if combustion is not perfect, poisonous fumes will be emitted. It is a gas of high calorific value; but in its production, according to recent practice, only one-third of the coal employed is utilized, and it must therefore be costly. As has been shown, if employed in the regenerative furnace, with a chimney temperature of 500°C., it is theoretically only 0·5 per cent. better than producer gas; and with a chimney temperature of 370°C., it is 2 per cent. worse, whilst in actual practice in the regenerative gas-furnace it is from 74 to 100 per cent. more costly than Siemens producer gas.—Yours, &c.,

GAS.

THE PUBLIC LIGHTING OF NEWCASTLE.—Last Sunday night week, in accordance with the decision of the Watch Committee (*ante*, p. 774), the lamps in the public thoroughfares and back streets of Newcastle were only partially lighted. About 1700 lamps in all were unlighted; and it is proposed to continue this system of partial lighting until Aug. 20 next. Several protests have been made by correspondents in the newspapers against this proceeding; the main contention being that public inconvenience would result from such a step, and that the small benefit to be obtained, from an economical point of view, did not justify the action of the Committee.

BOMBAY GAS COMPANY, LIMITED.—Reporting to the shareholders of this Company upon the operations of the half year ended December 31 last, the Directors say that the revenue shows an increase of £1782, as compared with the corresponding half of 1887. The cost of coal carbonized was greater, owing to the increased consumption, and also to the advanced prices of both coal and freight. During the half year the Company received remittances from Bombay amounting to £5000 at an exchange of 1s. 4⅛d. per rupee; costing rupees 71,910. The loss on this remittance—£2191—has been debited to profit and loss account, together with a further amount of £4000, which has been added to exchange equalization account. After placing £800 to the reserve fund for depreciation of plant, the balance at the credit of general revenue is £9797 17s., from which the Directors recommend a dividend of 4 per cent. (making, with the interim dividend already paid, 7½ per cent. for the year), free of income-tax. This will absorb £9600, and leave £197 17s. to be carried forward.

Legal Intelligence.

LAMBETH POLICE COURT.—Thursday, April 25.

(*Before Mr.* Partridge.)

SOUTHWARK AND VAUXHALL WATER COMPANY *v.* ABBEY WOOD BUILDING SOCIETY.

NEGLECTING TO PROVIDE CONSTANT SUPPLY FITTINGS.

In this case the defendants were summoned for refusing to comply with certain regulations in respect of property situate in the Landcroft Road, East Dulwich, of which they are the owners.

Mr. Tanner, who appeared for the Company, stated that as far back as October last notices were served on the defendants to carry out certain requirements necessitated by the introduction of the constant supply system to this district; and although repeated applications had been made to them to complete the alterations requisite, practically nothing had been effected. Persons like the defendants impeded the operations of the Company in effecting the transfer of the supply from the intermittent to the constant system, which was unfair to those owners of property who had completed what they had been called upon to do.

Mr. *D. Worger*, Assistant-Engineer of the Company, detailed at length a number of defects in the fittings at the houses mentioned.

Mr. Armstrong, for the defendants, submitted that they were willing to carry out the requirements, but asked for time to complete the work.

Mr. Partridge said he would adjourn the case for 14 days, to enable the defendants to carry out what was necessary; and then he would consider what penalty he should inflict.

WORSHIP STREET POLICE COURT.—Saturday, April 27.

(*Before Mr.* Bushby.)

THE PROVISION OF PROPER WATER-FITTINGS FOR THE PREVENTION OF WASTE.

To-day the New River Company, by their Solicitor (Mr. Beaumont), appeared in answer to a summons taken out by Mr. Reuben Button, a builder, of Kingsland, to bring the Company into Court in order that a dispute between him and them might be settled. Two cross-summonses taken out by the Company, after the first hearing, against Mr. Button alleged that he allowed waste of water in two houses belonging to him. The case has been before the Court on three previous occasions, and it had been shown that the dispute arose over some waste preventers which had been supplied to the houses. The Company alleged that these appliances were so indifferently made as to be inefficient and liable to get out of repair; and they called evidence that waste occurred in two houses.

Mr. Bushby said he should hold that the Company were not entitled to say of what strength the apparatus should be made, and that so long as it was effective with reasonable and natural use, and would last for a reasonable time—say, twelve months—the Company were bound to accept it. He therefore decided the initial dispute in favour of Mr. Button. As, however, the Company had proved waste with respect to two houses, they were entitled to succeed on their summonses, although they had only taken them as an after-thought, and when Mr. Button had been forced to protect his rights. He did not say that the Company had acted with harsh design, or that there was any complaint of that kind against them; but, as it would be monstrous to allow a Company of wealth and power to put a consumer to the expense of coming to Court, he made an order against them to pay Mr. Button £3 costs.

Mr. Button was fined 20s., and he gave to the poor-box the £3 paid by the Company.

GREENWICH POLICE COURT.—Wednesday, April 24.

(*Before Mr.* Fenwick.)

CONVICTION FOR PERMITTING WASTE OF WATER.

To-day, three adjourned summonses, which had been taken out by the Kent Water Company, against Mr. John Durham, of No. 55, Drakefell Road, Brockley, for permitting waste of water at No. 22, Mary Ann's Buildings, Deptford, and with unlawfully altering the water-supply apparatus, were disposed of.

Mr. A. Dickson, who appeared for the Company, stated that of late they had found an enormous waste of water going on in certain localities, and the offenders were difficult of detection. The Company had inaugurated a system of night inspection by which to ascertain where the loss occurred. They were obliged to furnish a constant supply of water, and in this they were considerably hampered by the prevalence of practices such as those resorted to by the defendant. The present proceedings were taken in the interests of the public, as well as in those of the Company, for it was absolutely necessary that such practices should be put a stop to.

Evidence was given by one of the Company's inspectors, named Perkins, to the effect that he visited the premises on the 19th ult., and found that the water-closet valve had been tied open; and, there being a constant supply of water to the premises, great waste was continually going on. There was also a burst pipe which was leaking very badly; and a tap had been left open, with water running from it, for eight days.

Defendant said he told the occupier that the water should be left running for one night only, to prevent a recurrence of inconvenience which had arisen through a burst pipe owing to frost. The fittings were the same as had been in use for the past 20 years; but he had now put in proper appliances to the Company's satisfaction.

Mr. Fenwick said defendant had, on his own showing, been guilty of great carelessness in not seeing that his instructions were properly carried out; and he should inflict a fine of £3 and 6s. costs.

A fourth summons, issued in respect of waste at No. 24 in the same buildings, was adjourned.

Rotherham Corporation Gas and Water Supply.—The Rotherham Borough Accountant's report for the year ending the 25th ult. was issued last week. In respect to the Gas Department, it states that the income arising from the sale of gas has increased by £130 9s., and residuals have produced an increase of £392 4s. As regards expenditure, there has been a saving of £88 11s. in manufacturing charges; but renewals and repairs have cost £624 8s. more than in 1887-8. Rates and taxes have also been £148 2s. 8d. heavier. The gross profit of the past year is £8102 17s. against £8236 14s. for 1887-8. The net surplus available, after deducting public lighting, gas and loan charges, is £2803, against £2993 9s. for 1887-8. Out of the surplus, £250 has already been appropriated to the School of Art Funds. As to the Water Department, the water-rental has realized £119 15s. more than in the previous year; but the income from meter accounts has fallen off £58 17s. Other sources of income from sales of water, however, exhibit improvements; and the total sales and receipts amount to £7809 5s., against £7652 18s. for 1887-8. As compared with 1887-8, the past year shows a gross profit of £4550, against £3607. The net deficiency is £623 9s., against £1539 17s. for 1887-8.

Miscellaneous News.

METROPOLIS GAS SUPPLY.

The Chief Gas Examiner for the Metropolis (Dr. Williamson, F.R.S.) has presented his report on the quality of the gas supplied by The Gaslight and Coke, the Commercial, and the South Metropolitan Companies, during the quarter ending March 31. The following is an abstract:—

I. *With respect to Illuminating Power.*—The average illuminating power, in standard sperm candles, at each of the testing-stations, was as follows:—

The Gaslight and Coke Company—	
Jewry Street, E.C.	16·0
King Street, E.C.	16·7
Dorset Buildings, E.C.	16·7
Ladbroke Grove, W.	16·5
Devon's Road, E.	16·8
Carlyle Square, Chelsea, S.W.	16·2
Camden Street, N.W.	16·4
Graham Road, E.	16·3
Kingsland Road, E.	16·6
Spring Gardens, Charing Cross, S.W.	16·8
Grove Gardens, Regent's Park, N.W.	16·1
Hornsey Road, N.	16·1
Lambeth Road, S.E.	16·4
Millbank Street, S.W. (cannel gas)	20·6
Commercial Gas Company—	
Parnell Road, E.	16·6
Wellclose Square, E.	16·5
South Metropolitan Gas Company—	
Hill Street, S.E.	16·5
Foster Place, S.W.	16·3
Stoney Lane, S.E.	16·3
Lewisham Road, S.E.	16·2
Burrage Road, S.E.	16·3
Blackfriars Road, S.E.	16·5

It will be seen from these results that the average illuminating power at all the testing-stations has been higher than the parliamentary standard. Several slight deficiencies in the lighting power of the gas were reported during the quarter at the Jewry Street, Spring Gardens, Grove Gardens, and Hornsey Road stations of The Gaslight and Coke Company; also at the Burrage Road station of the South Metropolitan Gas Company.

II. *As regards Purity.*—Sulphuretted hydrogen has not been present in the gas at any of the stations. The average amount of sulphur in other forms than this was considerably less at all the testing-stations than the limit allowed, which was not on any occasion exceeded during the quarter. With the exception of the City of London testing-stations, ammonia has been generally present in the gas throughout the quarter, but only in slight quantities. At the Foster Place and Lewisham Road stations of the South Metropolitan Gas Company it appeared seldom. There was no excess of ammonia on any occasion during the quarter.

PARIS GAS COMPANY.

The Report and Accounts for the Year 1888.

At the Annual General Meeting of the Paris Gas Company, which took place on the 29th ult., the report of the Directors on the progress of the undertaking during the twelve months ending Dec. 31 last was presented, together with the accounts for this period. The following is an abstract translation of the report, with the accounts in condensed form:—

The report opens with the statement that last year witnessed the inauguration of a new system of dividing the profits of the undertaking with the Municipality, on behalf of the City. Up to the end of 1887, the City received, as our readers are aware, half the profits made by the concern in excess of a sum of 12,400,000 frs., which was reserved for the exclusive use of the shareholders. From the commencement of last year, however, and on till the termination of the Company's concession, in 1905, the amount which the proprietors will be entitled to deduct from the gross profits, before dividing the remainder with the Municipality, will be reduced by 1,200,000 frs.; thus bringing down the figure from 12,400,000 frs. to 11,200,000 frs. In view of this fact, the Directors made special efforts last year to minimize as much as possible the effect of this change; and their labours were attended with success. As the balance of profit is divided equally between the Company and the Municipality, the shareholders really suffered to the extent of but 600,000 frs.; and not only was this covered, but the Directors were able, at the meeting, to offer the shareholders a dividend 1 fr. higher than that declared for 1887. The report next gives the usual full details as to the working of the undertaking, from which the following particulars are extracted.

During the past year the Company sent out from their works 297,697,820 cubic metres, or about 10,520 million cubic feet, of gas; being 6,923,280 cubic metres more than in the preceding twelve months. The day consumption—that is to say, the gas burnt in the interval between the extinction and the re-lighting of the public lamps—amounted to 76,422,708 cubic metres; being rather more than 25 per cent. of the total, and 4,666,768 cubic metres in excess of the quantity consumed in the daytime in 1887. The receipts from the sale of gas amounted to 76,878,181 frs., against 75,149,434 frs. in 1887—an increase of 1,728,747 frs. Of the first-named total, 70,960,106 frs. came from the city, and 5,918,075 frs. from the surrounding districts. The number of consumers at the close of the year was 212,515; being an increase of 11,980 as compared with the number on the books at the corresponding period of 1887. This is the first time in the Company's history that the number of new consumers has reached so high a figure in a single year. The nearest approach to it was in 1881, when 11,025 fresh customers were added to the register. The number of public lamps in use on Dec. 31 last was 65,072, of which 55,471 were employed in lighting the city. For the preceding year the figures were 63,887 and 54,437; so that there was an increase of 1185 in the total number of lamps, of which 1034 were put up in the city, where the Company have of late years effected great improvement in the street lighting by the employment of large lamps and high-power burners. Of this class of appliances there were in use in Paris at the close of last year, either by the Company or by private persons, no less than 3875, representing about 32,752 burners of the ordinary type. There were 1980 house services (pipes fixed to the fronts of buildings for the supply of the various "flats") laid on last year; which means that the Company introduced gas into 38 additional houses, on an average, each week. This is an increase of more than 8 per cent., and brings up the total number of these services in use at the close of the year to 25,670, distributed over 20,331 houses. The number of consumers taking a supply of gas in this way was 92,025; exceeding by 11,259, or 13·94 per cent., the number at the end of the preceding year. This class of consumers now represent 43 per cent. of the entire number; whereas ten years ago the proportion did not exceed 25 per cent. From this the Directors think it may be concluded that while the lighting of shops and warehouses, which was formerly so brilliant, shows a tendency to decrease, and some of the Company's largest customers—the theatres, cafés, and important retail establishments—have

adopted the electric light, gas is being used to a greater extent than ever in the houses. As explained in the previous report, the Directors offer special facilities to consumers who desire to employ gas for culinary purposes—placing gas-stoves at their disposal free of charge. That the public have shown their appreciation of this consideration, is testified by the fact that at the close of last year there were 47,051 gas-stoves in use by the Company's customers; and the Directors express the hope that by the end of the current year this figure will be doubled.

Passing on to deal with the condition of the works and plant, the report states that their manufacturing power was not increased last year. The works were quite equal to the demands made upon them in the past winter; and the Directors estimate that they will suffice for the next. They nevertheless purpose bringing into use, in the course of the present year, the first section of the new works at Le Landy, which will more than compensate for the decrease in productive power resulting from the stoppage of the Belleville works last year, the plant in which, being antiquated and expensive to operate, would have required to be entirely reconstructed. With regard to the distributing plant, some important canalization works have been carried out in order to improve generally the conditions of supply, and to bring into the centre of Paris the gas made in the works at La Villette and Le Landy. The mains have been extended by 24,715 metres, or about 16 miles; bringing up the total length to 2,172,213 metres, or about 1346 miles.

Coming to the financial part of the report, we find that the expenditure on capital account last year amounted to 7,951,777 frs. (£318,071), the bulk of which was laid out on the new works already referred to at Le Landy, and a large portion of the remainder on house services, service-pipes, and meters. The capital account stood as follows on Dec. 31, 1888 :—

	Francs.	Sterling.
Amount expended to Dec. 31, 1887	261,027,793	£10,441,112
Do. do. during 1888	7,951,777	318,071
Total on Dec. 31, 1888	268,979,570	£10,759,183
To meet which there has been raised—		
By shares. 84,000,000 frs.		
By bonds 197,245,739 „	281,245,739	11,249,830
Showing an unexpended balance of	12,266,169	£490,647

The following is the working account for the past year :—

Expenditure.

	Francs.	Sterling.
Value of gas in store on Jan. 1, 1888	43,474	£1,739
Manufacture of gas—		
Coals carbonized	20,409,759	816,390
Coke and tar for heating purposes	4,566,189	182,648
Salaries and wages	4,164,478	166,579
Maintenance of works and plant	2,214,453	88,578
Incidental expenses of carbonization	1,416,044	56,642
Purifying material	388,682	15,547
General expenses	116,627	4,665
Distribution—		
Salaries of Engineers and officers	1,483,864	59,355
Repair and maintenance of mains and services	1,397,116	55,885
Allowances, premiums, stamps, &c.	11,624	465
Printing and advertising	216,315	8,653
Miscellaneous	59,677	2,387
General management—		
Board of Directors and Executive Committee	150,000	6,000
Salaries	1,028,204	41,128
Office and other expenses	319,137	12,765
Service, accidents, relief, &c.	145,297	5,812
Law and other charges	31,739	1,270
Bad debts	22,562	902
Rents and insurances	256,952	10,278
Interest on loans	8,567,275	342,691
Loan redemption fund	5,479,500	219,180
Share redemption fund	2,155,500	86,220
Cost of experiments, &c.	108,457	4,338
Contributions to pension and provident funds	258,302	10,332
Municipal charges—		
Tax of 2c. per cubic metre of gas sold	5,239,184	209,565
Rent of subsoil occupied by mains, &c.	200,000	8,000
Lighting, extinguishing, and maintenance of public lamps	987,552	39,502
State charges—		
Official Gas Examiner, stamps, and taxes.	1,049,663	41,987
Total expenditure	62,487,576	£2,499,503

Revenue.

	Francs.	Sterling.
Value of gas in store on Dec. 31, 1888	42,746	£1,710
Sale of gas	76,878,181	3,075,127
Residual products—		
Retort coke	16,258,282	650,131
Tar	2,202,042	88,082
Ammoniacal liquor	1,112,516	44,500
Rent of meters and fittings on hire	3,058,519	122,341
Fire-bricks, retorts, &c.	147,805	5,912
Interest and discount	1,133,541	45,342
Miscellaneous	115,954	4,638
Total revenue	100,944,586	£4,037,783
Deduct expenditure	62,487,576	2,499,503
Balance, being profit made in the year 1888	38,457,010	£1,538,280
Add balance brought forward from 1887	25,571	1,023
	38,482,581	£1,539,303
Deduct to meet outstanding claims	182,581	7,303
Balance available for distribution	38,300,000	£1,532,000
Deduct for share dividend	11,200,000	448,000
Balance, divisible equally between the Company and the Municipality	27,100,000	£1,084,000

The total amount available for distribution among the shareholders is therefore as follows :—

	Francs.	Sterling.
Dividend as above	11,200,000	£448,000
Half of divisible balance	13,550,000	542,000
Portion of repayment by Municipality of an advance made yearly by Company	50,000	2,000
Balance of undivided profits	322,177	12,887
Total	25,122,177	£1,004,887
Deduct 1 fr. per share for special reserve fund	336,000	13,440
Balance	24,786,177	£991,447
Deduct interim dividend of 12 frs. 50 c. per share paid in October last	3,031,975	121,279
Balance available for final dividend.	21,754,202	£870,168

The balance allowed of a further payment of 65 frs. 50 c. per share of 250 frs.; making altogether 77 frs. per share, and leaving a balance of 82,202 frs. (£3288) to be carried forward.

With regard to the residual products, the report states that the sale of coke last year was about the same as in the preceding twelve months. The comparatively mild weather in the closing months of the year caused an appreciable diminution in the consumption of coke for domestic purposes; but this was made up to a certain extent by sales for the provinces and for industrial uses. The receipts for coke amounted to 16,253,282 frs., as against 16,607,852 frs. in the previous year—a drop of 354,570 frs., or about £14,183. The tar and manufactured chemical products, however, showed an improvement; the receipts being:—Tar, 2,202,041 frs.; chemical products, 1,112,516 frs.—total, 3,314,557 frs., against 3,120,726 frs. in 1887, and 3,236,905 frs. in 1886. The Directors remark on this subject that the disposal of these products is always difficult, as there is only a limited market for them, and the demand tends rather to diminish than to increase. As to the other sources of income, there were 24 horizontal gas-engines sold last year, representing a total of 127-horse power, against 23 engines in the preceding year, representing 76-horse power. The quantity of gas consumed by gas-engines actually at work in Paris may be estimated at about 3 million cubic metres, or 106 million cubic feet per annum. Of appliances for heating by coke, 1107 were supplied; bringing up to 63,809 the total number of these articles which have left the Company's workshops. This is a slight falling off as compared with 1887.

The other matters dealt with in the report need only a brief notice. The Company's reserve fund at the close of last year amounted to 12,299,234 frs.; the pension fund to 3,074,183 frs.; the provident fund had a balance of 17,796 frs.; and the savings fund stood at 196,390 frs. The applications made at the Company's offices for information in regard to the use of gas (information which is always readily given by officials specially selected for the purpose) were almost twice as numerous last year as they were in 1887. This fact, taken in conjunction with the increase in the number of consumers, is, the Directors consider, strong testimony of the vitality of the gas industry, the progress of which has not been checked by the competition of the electric light. Several large establishments, concert-rooms, theatres, colleges, &c., have adopted, under the advice of the Company's officers, systems whereby the heat developed by the combustion of gas has been usefully employed in ventilation. The arrangements adopted have, the report states, succeeded perfectly; and the Directors consider that they cannot fail to serve as examples for a great number of similar cases. Such employment of gas under rational and hygienic conditions will, they are certain, contribute very materially to the still further development of its consumption.

PARTICK, HILLHEAD, AND MARYHILL GAS COMPANY.

An Adjourned Meeting of this Company was held last Tuesday—Mr. Henry Cowan presiding—for the purpose of further considering a resolution for issuing debenture stock or annuities to the extent of £80,000 at a rate of interest not exceeding 4 per cent. per annum in perpetuity.

The Chairman, in opening the proceedings, remarked that the meeting held on the 11th inst. (*ante*, p. 725) was adjourned in deference to the wishes of some shareholders then present, who desired an opportunity of tendering for the debenture stock to be issued, and asked for a short time to mature some scheme for apportioning the stock amongst the shareholders. Since then no proposal had been received by the Directors, except an offer from a few shareholders at the last meeting to take up, in all, about £10,000 of stock—without any guarantee that the remainder of the £80,000 would be taken up if required. As against that request, the Directors held an agreement from other shareholders holding a larger amount of the ordinary stock, and having therefore as great a claim to the debenture stock, by which they bound themselves to take up at par the whole £80,000 of debenture stock as it might be required. It would be for the meeting to judge whether the resolution which he had to propose should be adopted, which would have the result of enabling the Directors to accept the offer they had received, or whether it should be negatived, in which case it might be open to the shareholders to try to raise the money themselves. He desired to say that the scheme of the Directors was carefully considered by them before it was submitted to the shareholders; and all advantages and disadvantages were fully weighed. The advantages of the provisional arrangement which they had entered into were—First, that an absolute guarantee was given by responsible parties that the whole £80,000 of stock would be taken at par, if and when required; and, second, that the financial position of the Company, not only for the present but for the future, would be secured, and tangible evidence afforded to the public, and in view of possible contest with their opponents in Parliament, of their ability to meet all the demands in the way of gas supply, both present and prospective, of the important district which, to a great extent, was entirely in the Company's hands. It was conceivable that it would have been to the advantage of the Company if other terms had been secured. If, for example, the stock had been made redeemable at the end of ten or twenty years, or if a premium had been obtained on the issue—if the Directors could have procured such terms, they would have done so gladly; but promising as the Company's prospects were, such terms could not be got. A provision for redemption at a premium, would, in the opinion of the Directors, be prejudicial to the Company's interests, as, in the event of circumstances arising in which the claim of the debenture stockholders against the Company required to be valued, such a provision would probably be taken as indicating that the premium stipulated for should be paid; and if power to redeem at par were asked, the inducement to the parties with whom the Directors were dealing would obviously be taken away. Whether the stock would be worth a premium or not would depend on the general success of the Company. If the future was prosperous, they would not grudge the debenture stockholders a share in the prosperity; while if it was the reverse, they, as well as the Directors and shareholders generally, would no doubt share in any depression in the market value which might result. On the whole, they considered that it was for the interest of the Company to accept the proposed arrangement; and, without further remarks, he moved the special resolution contained in the notice calling the meeting, the substance of which was given in the Journal for the 9th inst. (p. 675).

The motion having been seconded,

Mr. Begg said he was not prepared to submit an amendment to the motion proposed by the Chairman; but he thought it right to state that he recognized the merits of the proposal submitted by the Directors. He then proceeded to state briefly what he had done on the day following the former meeting, which was that he had himself been able to get promises from shareholders to take up amongst them stock amounting to about £30,000, which would doubtless meet the wants of the Company for at least eighteen months. He had no doubt that the remainder of the sum named in the Directors' scheme would be quickly taken up.

Mr. Todd remarked that the shareholders ought to know the names of the members of the Syndicate by whom the £80,000 had been promised to the Directors. The parties might be mere financial adventurers—men of straw—for all that the shareholders were likely to know.

The Chairman said the Directors were perfectly satisfied on that point.

Mr. J. Wilson, M.P., strongly urged the shareholders to endorse the action of the Directors, and pass the resolution.

Mr. T. Kirkhope expressed the opinion that the resolution was illegal; and he thought that the rate of interest ought to be reduced, or that the Directors should fix a price at which the debentures could be redeemed. Otherwise the Company would be in the hands of the Syndicate; and in the event of the city approaching them with a view to the purchase of the works, which he thought was extremely probable, the parties to the agreement might dictate their own terms.

Mr. Muirhead, the Company's Legal Adviser, remarked that the point raised by Mr. Kirkhope had been fully considered by the Directors. The parties would not be in a position to dictate; it would be a matter to be settled by the Court.

Mr. Kirkhope then moved a direct negative to the Chairman's motion, which was seconded by Mr. Begg.

On the vote being taken, the motion was declared carried.

A poll was demanded; the result being that the shareholders, including the proxies, who voted for the resolution, represented 12,717 shares, and for the amendment 2014 shares. The resolution was therefore again declared carried.

Mr. Kirkhope afterwards read and handed to the Chairman a formal protest, which was signed by himself and Messrs. Begg and Steel, against the legality of the resolution and the validity of the vote.

The proceedings then terminated.

STALYBRIDGE CORPORATION GAS SUPPLY.

The Working of the Past Year.

The Engineer of the Stalybridge Corporation Gas-Works (Mr. E. A. Loam) in his report to the Gas Committee for the year ending March 25 last, says that the amount of coal carbonized for the year was 12,042 tons; and the make of gas per ton was 10,222 cubic feet, against 9937 feet last year, or an increase of 285 cubic feet per ton. The quantity of gas manufactured was 123,096,800 cubic feet, against 122,673,200 feet last year, or an increase of 423,600 cubic feet, with a decrease in the amount of coal carbonized of 303 tons. The quantity of gas sent out was 123,164,400 cubic feet, against 122,527,300 cubic feet last year, or an increase of 637,100 cubic feet. The cost of coal, after deducting the amount received for residuals, was £3944; and the working expenses for manufacture, distribution, &c., were £5517—making the total cost £9461, against £10,274 last year, or a decrease of £812, equal to 15s. 8·58d. per ton, against 16s. 7·72d. last year. The cost of gas sold per 1000 cubic feet was 1s. 9·37d., against 1s. 11·17d. last year. The quantity of tar and ammoniacal liquor produced was 2027 tons, against 1859 tons last year, or an increase of 68 tons, equal to £126. The tar and liquor made per ton of coal carbonized was 35 gallons. The average illuminating power of the gas was 19 candles. The existing regenerator bed, it is stated, will be rebuilt before the winter season, with a modern bench of retorts capable of producing 42,000 cubic feet of gas per diem. Mr. Loam points out that the total gasholder capacity is equal to 840,000 cubic feet, or 69,000 cubic feet under the largest day's consumption, with all the retorts in full action; he urges the necessity of providing additional storeage accommodation, and suggests that a three-lift telescopic holder, with a capacity of 750,000 cubic feet, or even a million feet, shall be shortly constructed. This would meet the requirements for a number of years to come; and he roughly estimates the probable cost, including brick tank and telescopic gasholder, at from £11,000 to £12,000. Mr. Loam also points out the great benefit that would accrue if the Committee decide to add to the plant one of Walker's washers; and, in conclusion, says that he thinks the past year's working may be considered very satisfactory.

WIGAN CORPORATION GAS SUPPLY.

Finances of the Gas Undertaking.

According to the abstract of the accounts of the Wigan Corporation for the year ending the 25th ult., which has just been issued by the Borough Treasurer (Mr. W. T. Wanklyn), the profit on the manufacture and sale of gas in the twelve months was £18,664, against £16,125 in the preceding year. The former sum, with £2144 brought forward, made a total of £20,809 on the credit side of the profit and loss account. After paying interest on debenture stock, bankers' interest and commission, placing £2183 in the sinking funds, and meeting other charges, amounting in all to £12,462, there was at the close of the financial year a balance in hand of £8347, against £2144 at the corresponding period of 1888. There was an expenditure on capital account to the extent of £3276; bringing up to £265,386 the total amount invested in the gas undertaking. On this account there is an amount of £15,166 owing to the bankers. The revenue account shows that the sale of gas for public and private lighting, and the rental of meters produced £36,160; the residuals, £7716; and miscellaneous matters, £436—total, £44,312, against £42,055 in the year 1887-8. The following are the chief items of expenditure:—Manufacture of gas, £13,376 (the coals carbonized costing £9660); distribution, £930; rents, rates, and taxes, £2403; management, £505—the miscellaneous items making up a total of £25,648, against £25,930 in the preceding year. The sale of gas again shows an advance—£30,665, against £30,051 in 1887-8; and £29,780 in 1886-7; and the receipts from tar and liquor are better. The net profit realized by the manufacture of sulphate of ammonia, however, has fallen very slightly—£1147 8s., against £1151 16s. in 1887-8. The quantity of coal carbonized in the works (which are under the management of Mr. J. Timmins) in the past year was 20,945 tons 9 cwt.; the residuals being as follows:—Coke, 12,648 tons 2 cwt.; breeze, 927 tons 16 cwt.; tar, 1345 tons 17 cwt. 2 qrs.; ammoniacal liquor, 3722 tons 13 cwt.; sulphate of ammonia, 267 tons.

Sale of Stock in the Henley-on-Thames Gas Company.—Last Thursday, £1800 of new 7 per cent. stock in the Henley-on-Thames Gas Company was sold by auction in 36 lots, with the following results:—One lot at £72, seventeen lots at £73, sixteen lots at £74, one lot at £75, and one at £76; the total amount realized by the sale being £2648.

The Profit of the Rochdale Corporation Gas-Works.—The accounts which have just been made up show that in the year ended the 25th ult. the total revenue of the Rochdale Corporation Gas-Works was £53,627; while the expenditure was £40,664. This leaves a balance of £12,963 as the profit on the year's working of the department—a sum which falls short by £2540 of the profit (£15,503) realized last year. Notwithstanding this apparent decrease in the surplus, the result of the year's working is very satisfactory; for the falling off is more than accounted for by the two reductions of 3d. per 1000 cubic feet each which have been made in the price of gas, and by the expenditure incurred in the renewal of the sulphate plant. This plant cost rather more than £1000; but only half this sum was charged to revenue—the remainder being debited to the reserve fund. The reductions alluded to above were made in May of last, and January of the present year. The net revenue from, or profit made on the gas sold during the twelve months amounts to £3100 less than that obtained last year; but the net revenue for residuals has increased by £1400.

GAS SUPPLY IN DENMARK.

The last number of *Engineering* contained an interesting article, based on some particulars given in a Danish newspaper, on the production of gas in Denmark. We learn therefrom that Copenhagen is the only capital which has built gas-works on its own account. In the years 1853 and 1854, the Danish Gas Company (an English undertaking) put up eight gas-works in the kingdom—viz., at Odense, Aarhus, Elsinore, Aalborg, Viborg, Randers, Veile, and Flensburg; and in 1860 one at Frederiksberg, a large suburb of Copenhagen. These works represent about the whole of those which have been built by private enterprise. There are now in Denmark altogether 36 gas-works, of which eight belong to the Danish Gas Company, one to another Company, and the remainder are the property of the respective Corporations. During the year 1886 the total production of gas in Denmark amounted to 980,631,720 cubic feet, of which no less than 594,517,000 cubic feet came from the Copenhagen Gas-Works. The production of gas is steadily increasing; as it was only 705,731,600 cubic feet in the year 1881. The increase is largest in the towns where the works belong to the English Company, as they have done much in various ways to encourage the use of gas for heating and cooking, for which purposes the price of gas was reduced as far back as 1882-3. The largest yearly consumption of gas per individual is in the town of Nakskov, with 4400 cubic feet for each person. Otherwise the consumption varies between 1000 and 2000 cubic feet per head. For public lighting, about 98 million cubic feet are used in all Denmark; and the gas-lamps amount to 6832 in the 27 towns which possess their own gas-works. The coal consumption at all the Danish gas-works amounted in 1886 to 98,271 tons—costing rather more than £70,000; the coke produced realizing about £55,000. The total value of all the gas-works in Denmark is something like £818,000. The proportion between the consumption of gas for lighting and cooking purposes varies greatly in the different towns. In two small towns, where gas for cooking has been cheaper than lighting gas for more than 20 years, the consumption of the former has been proportionately very large; in one town the consumption of cooking gas was in 1887 more than twice that of gas employed for lighting purposes. The average sale of cooking gas in the 27 towns where there are different prices for cooking and lighting gas is about 27 per cent. of the total sale of gas; whereas it only amounts to 10 per cent. of the consumption for the whole country. "These few figures," says our contemporary, "not very important in themselves, tend to show very distinctly what a wide field for gas consumption cooking and heating may afford, only it appears to want some cultivating—a circumstance which may be able to counteract the competition of the electric light, which, so far as Denmark is concerned, is heavily handicapped by the many Corporation gas-works."

SALE OF THE LACLEDE (ST. LOUIS) GAS-WORKS TO A SYNDICATE.

For some time past the gas affairs of Laclede (St. Louis) have been in a rather perturbed state, owing to attempts which have been made to force the Laclede Gas Company to join the Gas Trust which has been established in St. Louis, consisting of the St. Louis and Carondelet Companies. In order to precipitate the desired result, a Water-Gas Company was started to compete with the Laclede Company; and it appears to have been very nearly successful; for many of the stockholders of the original Company became discouraged, and manifested a wish to join the Trust. The Directors, however, recognizing the strength of their position by having a perpetual Charter, and no limitation as to price, succeeded in "pooling" nearly all the stock; issuing, in returning, certificates specifying that the holders should, before offering them for sale, give the Directors a chance to buy. In this way confidence was maintained, the raids on the stock were speedily checked, and its value preserved. Negotiations with the Directors, were, it appears, subsequently talked of; and it was thought the result would be that a combination would be effected, and that the two Trust Companies would soon be operating under the Laclede Charter. But events took a different course. Offers to purchase the concern were made by the representatives of an Eastern and European Syndicate; and these have been accepted by the Directors of the Laclede Company. The prime movers in this Syndicate are the Vanderbilts; Mr. R. Laird, a London banker; the Philadelphia Gas Trust; Mr. Belmont, the American representative of the Rothschilds; and Mr. W. W. Gibbs, one of the leading spirits in the St. Louis Gas Trust. The condition of the transfer of the undertaking was the deliverance of four-fifths of the entire stock of the concern within ten days from the 31st of March last; and the price to be paid was to be $140 for each $100 share. The shareholders were apprised of the terms; and before the specified time, more than sufficient had signified their assent, and it was fully expected that nearly every share would be sent in. By the 10th inst. therefore, the bargain was completed, and the concern handed over to the Syndicate. The transaction has involved a cash payment of about $3,500,000. The capital invested in the undertaking amounted to $2,500,000, on which a dividend of 8 per cent. has been paid. It is thought probable that as soon as the works and property are fairly in the hands of the Syndicate, negotiations will be re-opened for a union with the St. Louis Trust, and the coal-gas interest consolidated against their water-gas rivals.

Mr. W. J. Crossley on Gas-Engines.—In the report which we gave last week of the lecture delivered by Mr. W. J. Crossley at Manchester, on the use of gas-engines, it was stated that, of the 245 gas companies referred to as having replied to a circular sent out to ascertain their practice in relation to the consumption of gas for power and heating, "50 did *not* make a special rebate" on gas used for engine purposes. The sentence should have read "did *now* make a special rebate." In a communication to a Manchester paper last week, Mr. Crossley stated that several companies make a rebate of 1s. for gas consumed in this way; and added that out of 80 big gas companies or corporations in Germany, 27 make a rebate of from 20 to 47 per cent. for large consumption and engine purposes—15 of these making the rebate for engine purposes alone, with the result that gas-engines of much larger power were being used than could economically be employed with high-priced gas.

New Joint Stock Companies.—The Smoke Abatement Corporation, Limited, has been registered with a capital of £50,000, in £1 shares, to acquire the rights and interests in the invention and patent for "a new and improved compound for the prevention of smoke in furnaces and other fireplaces." Clarke's Pyramid and Fairy Light Company, Limited, has been registered with a capital of £50,000, in £10 shares, to acquire and carry on, as successors to Mr. S. Clarke, of the Pyramid and Fairy Light Works, Cricklewood, the business now carried on there, with the goodwill, patent and other rights, trade marks, and assets thereof. The Lothammer Gas Manufacturing Company has been started, with a capital of £60,000, in £1 shares, to acquire the British, American, German, French, and Austro-Hungarian patents for Mr. J. F. Lothammer's apparatus for the manufacture of gas, which was noticed in our editorial columns a fortnight ago.

ELECTRIC LIGHTING IN THE METROPOLIS.

BOARD OF TRADE INQUIRY.

(*Before Major* MARINDIN, C.M.G., R.E., *assisted by Captain* CARDEW.)

SIXTH DAY—WEDNESDAY, APRIL 10.

Mr. C. A. CRIPPS stated that he proposed to hand in a copy of an agreement which had been settled between the Metropolitan Electric Lighting Company and the Strand District Board of Works, providing for the construction of works and supplying the district with light. The District Board were willing that the Company should supply the light within the district; and the whole of the agreement was based upon the fact that the District Board were willing to accept the supply from the Metropolitan Company. With regard to the price at which the light should be supplied and the current, the agreement was similar to the Provisional Order. The Order stated that the undertakers might charge for the electricity supplied by them to any ordinary customer by the quantity of energy contained in the supply, by the actual quantity of electricity supplied, or by the number of hours during which the supply was actually used by such customer, and the maximum current with which he was for the time being entitled to be supplied. As to the charge for public lamps, this was to be settled between the local authorities and the undertakers. The undertakers, upon receiving reasonable notice from the local authorities requiring them to supply electricity to any public lamps within 50 yards of any of their mains, should supply the lamps in such quantities as the local authority might from time to time require. Then in the event of the failure of the supply, whenever the undertakers failed to supply any owner or occupier of premises to whom they might be or were required to supply electricity, they should be liable to a penalty not exceeding 40s. in respect of every such default for each day during which it occurred; and whenever the undertakers made default in supplying electricity to the public lamps, the penalty was to be a sum not exceeding 40s. in respect of every default, and for each day during the same, provided that the penalties should not in any case exceed in the aggregate £50 in respect of such default upon the part of the undertakers, and provided also that in no case should any penalty be inflicted in respect of any default if it was caused by inevitable accident or *force majeure*, or was of so slight or unimportant a character as not to materially affect the value of the supply, or where the default was not wilful on the part of the undertakers. The learned Counsel then said that the putting in of the agreement completed his case.

Major MARINDIN: I think it is desirable for someone to be examined with regard to this agreement.

Mr. *Claremont* was then recalled, and, in answer to Mr. PEMBER, said the agreement had not been executed. So far as he was aware, except as an honourable understanding, it had no validity.

Mr. PEMBER: If you obtain your Provisional Order, will you execute this agreement?

Mr. CRIPPS objected to the question being put to the witness, and said that the Company's intention certainly was to execute the agreement.

Mr. *Beaumont Maurice* was next called, and, in reply to Mr. PEMBER, said that he drew up the agreement, and had no doubt it would be executed if the Provisional Order were obtained. He added that the Company hoped for, and expected a monopoly; and some of the concessions in the agreement might have been unnecessary if there were competition in the district. He did not think there was any difference between the agreement and the Order as to the price to be charged. It was desirable that a parliamentary maximum as to price should be fixed.

Mr. PEMBER: The consumer is by the Order bound to take 15 units for £5 10s. as a minimum, and for every unit the Company may charge him 6s. 8d.

Witness: That is so; but it is somewhat different in the agreement.

I see that in the schedule to the agreement there is a provision about amps, that where the supply is by lamps the undertaker shall be entitled to charge for each light, if it is a continuous supply, at the rate of 30s. per annum, and for an intermittent supply, at the rate of 25s. per annum. There is no such provision as that in the Order?—No.

Under article 8 you have a serious modification of your Order as to price?—It is a revision of prices.

Under the Provisional Order there is a power whereby a certain number of consumers can request you to supply the light; but they are to guarantee 20 per cent. on the outlay. But I notice this, there is power given to the District Board to request a supply for the service of public lighting, and they are entitled to require you to lay mains for that purpose without giving you any guarantee as to the cost?—Yes, that is so; but it is not such an important concession as it appears.

The lighting of public lamps is about the most unremunerative kind of lighting which such a company as this can undertake?—Yes; but I do not know what the value may be as an advertisement.

As to the question of penalty, is there any other case where it is inflicted?—I think under the Gas Acts.

In the City, if you do not lay down mains you are subject to a penalty of £5 a day?—That is under clause 13.

But this goes a great deal further. In fact, it comes to this: Except under certain circumstances the supply is not constant, to speak loosely, and if you fail to supply electricity in the same sort of way as the gas companies, you are to be under a penalty of £100 for every default and of £5 a day for every day of its continuance—is there anything like that in the Gas Acts?—I do not know as to gas; but with regard to water you are bound to lay mains, and if you do not you are subject to a penalty.

Mr. CRIPPS said, in reply to Mr. Pember, that the Order applied to the whole of the mid-London area, whereas the agreement was intended to meet the special circumstances of the Strand District. It was for the Board of Trade to say whether the Strand could be separated.

Mr. PEMBER said further, with regard to the question of penalty for failure in supplying electric light, that by the Gas-Works Clauses Act, 1847, amended by the Act of 1871, wherever the undertakers neglected or refused to supply gas to any owner or occupier entitled to the same under such pressure as was prescribed, they should be liable to a penalty of 40s. during each day of such default; and also, if they refused the supply of gas in accordance with the provisions of the Act, they should be liable to a like penalty of 40s. There was considerable difference between 40s. and £100.

Witness: The difference is between 40s. and £5 a day.

Mr. CRIPPS (who represented the Strand District Board of Works) asked a few questions with the view of learning the history of the agreement; and witness stated that a similar letter which the Strand Board received from the London Electric Supply Corporation had been received from the Metropolitan Company. He was instructed to make every effort to meet the views of the Board. He could not go so far as to say that the agreement was equivalent to a kind of partnership between the Company and the District Board as to electric lighting in the Strand. At the outset there was an idea that the agreement was conditional upon the exclusion of competitive companies from the Strand. If the agreement worked satisfactorily and in the interests of the Strand, he hoped the Board would not disturb it and admit any other competing electric lighting company. But if it did not work satisfactorily, there was a provision under which it could be cancelled and determined. Apart from that there was no understanding that the Strand District Board of Works should divest itself of any power to consent to a future application for a Provisional Order by any other company.

Re-examined by Mr. CRIPPS, witness said that the penalty under the agreement was larger in amount than that proposed in the Order and higher than under the Gas-Works Clauses Act of 1847; but the principle was the same as under that Act—viz., that if there was a default they should become subject to a penalty. There was no agreement or understanding that the Company should have a monopoly of the lighting of the Strand district.

Mr. MOULTON then opened the case on behalf of the Chelsea Electric Supply Company, the Electrical Power Storeage Company, and the Telephone Company, all of whom he represented. He said it was the desire of the representatives of all the Companies who were endeavouring to give a continuous supply, to shorten the inquiry, and to have the points which were common to their various cases opened only once, in so far as it was practicable. He therefore opened the general case with regard to the direct supply, specially with the use of storeage batteries. He thought he might say their interests came into conflict—so far as they were conflicting at all, and this was not to any great extent—only on the question of area. They were all of opinion that the steps taken by the Board of Trade in 1883 and 1884, after very patient consideration and examination, were right, and that there was no reason why they should now be departed from. Of course, he did not say that knowledge and experience had not since been gained; but the bearing of electrical knowledge on the practical problem with which the Electric Lighting Orders were intended to deal had only justified and strengthened the ground for the conclusions to which the Board of Trade then came. In 1882 the Electric Lighting Act was passed, in his opinion, under the influence of very strong feelings of a special character. He did not say that it was a party measure; but he thought the Act was injured very seriously by the overwhelming importance which was given to certain political considerations as to the position of local authorities. The terms granted, under the pressure brought by the municipal authorities, to electric lighting undertakers were such as did not give any well-established ground to expect a fair commercial return for their capital in a great majority of cases. This was altered by the Act of 1888; and although he did not sympathize with that Act, it was a great concession to electric lighting companies in general, and it had admitted that the legislation of 1882 was in error as concerned the unfavourable character of the terms which it gave to the electric lighting undertakers. This blunder was admitted by the Legislature, and they corrected it; but this did not in any way effect what the Board of Trade had done in 1883. The problem then was this: Given a public need or desire for electric lighting, and given the powers which they intended to be conferred upon electric light undertakers by the Act of 1882, what was the fairest form of that special legislation which would limit and define those powers in each case? This problem the Legislature had never attempted to deal with, but had wisely left to the Board of Trade. In 1883, the Board drew up a Model Order, every line of which had been subjected to close examination and discussion; and the case of his clients was that this Order was the right one, and that it gave even-handed justice alike to the local authorities and the companies. His clients thought the company who asked for powers to become undertakers for electric lighting in a district in London ought to be allowed to put itself under the restrictions and responsibilities of that Order; because although they were sufficient to keep the company fully up to its duties, yet if it was prepared to discharge its duties efficiently, those provisions would enable it to do so, and there would be a prospect of a reasonable commercial return. Where the companies made an attempt to seriously vary the Order, the Board of Trade should, in the interests of both parties, decline to accede to the proposal; and he thought that practically the Model Order of the present year should be taken from that which was settled in 1883. The Chelsea Company was the only one that was bold enough to obtain, and try to carry out an Order under the terms of the 1882 Act. It would be seen that substantially the contest now was between two classes of Orders—some which wanted to adhere practically to the policy of the Board of Trade in 1883, and others which wanted to throw over that policy; and this division was substantially coterminous with the divisions between the direct and the alternating systems. The direct supply, was, he considered, the cheapest, best, and most convenient. It was the best for the consumer, because it was most easily capable of being made regular and dependent; and it was the one that was farthest removed from any risk of extinction of the light. The transformer system was, no doubt, of enormous advantage in dealing with a straggling supply; but the question of the advantage it gave to the consumer was of far less importance than that of the danger attending it. Its liability to sudden extinction was incurable. It appeared to him that those who were supporting this system only wanted powers over a huge area; and those powers being given, they would be able to occupy the places in which they could furnish electric light most cheaply, but which were the cream of the district, so that in this way they would practically have a monopoly. But whether they did or not, it would not matter to them, as other companies would not think it worth their while to compete for the unremunerative part of the area. If this policy were adopted, the Corporation which they opposed would get the largest and best part of London, and be able to hold it. This policy, however, would be an absolute abandonment of the 1883 Order. He stood by the Order, because his clients wanted to have a piece of the area for themselves, so that they might work it with the direct supply. They were willing to bear the burden of electric lighting in those portions of the area where it was not so profitable, if they were allowed to have the parts where it was fairly profitable. But it must be upon the conditions that there was to be no competition where the Company was doing its work well, and was complying with all the regulations imposed upon it. In saying this, he was repeating the arguments which the Board of Trade used in 1883, which were conclusively in favour of districting as against competition. Of all the industries which might be mentioned, there was none in which the cost of production was so intimately connected with the amplitude of the demand as that of electric lighting. Electric lighting in small quantities was an exceedingly expensive luxury; and the larger the demand became, the smaller in proportion would be the cost of producing the electricity. The demand should be large in proportion to their plant, in order that it might be fully occupied. The conditions of an economical supply depended very largely upon the demand. If they were going to give one company a monopoly over a large area, it would not be beneficial to the public. There was already in existence a tremendous rival in the gas companies—a rival that was capable, without crippling itself, of supplying light at a price which he scarcely dared to think of, except as a consumer; and he as an advocate of electric lighting, thought that if some electric lighting companies were compelled to compete with other companies in point of price, in addition to the competition of the gas companies, they would have a very hard struggle. There could be no doubt about it that the gas companies, having so many other things out of which they could obtain a profit, could afford, in order to strangle

a dangerous rival, to make very great sacrifices in respect to the price at which they supplied gas. So that it would be seen that there was already great competition for the electric lighting companies in any case. He admitted that if there was no competition there was not that inducement to lower prices that there would be if there was a second company in the district; but he would ask the Inspector to consider what there was against them if they were to have two companies. They would have the area twice covered, although only the same number of persons had to be supplied with light; and having this there would have to be double mains throughout the area. The consequence would be that the cost of supplying the electricity would be greatly increased. If it was to be done under proper supervision, and according to the requirements of the Board of Trade, no electric lighting company would be able to make exorbitant profits. They would, however, soon feel the pressure of public opinion, and the possibility of competition. There was another reason why the electric lighting companies should be willing to supply cheaply, and that was because by so doing it would increase the demand and reduce the proportionate cost of supplying it. His view against over-districting had been approved by the Board of Trade in 1883. It was then said that the competition with gas was likely to be very severe; and that this, coupled with competition with the other electric lighting undertakers, would keep down the price. It was urged that there should be potential competition, coupled with undisturbed monopoly so long as the companies were doing their work properly; and that in this way they would get the stimulus of competition which would keep down the prices, without the evil of competition forcing them up, rendering the supply of electric light an uncertain industry, and causing the selfishness of the companies to outbid one another, thus preventing a fair return being obtained upon the capital, and so driving prudent investors away. The reason for his clients opposing the Orders of the Metropolitan and the London Companies, was because they wanted that kind of dealing which the Board of Trade thought was fair to everybody; and they were prepared to accept clauses which would compel them to do their work properly. They were ready to accept potential competition, if they could obtain their Orders on the distinct understanding that, if they did not do their duty, others should be allowed to come in and do it. But they asked that time should be given to each company, and that each should have an area to itself—moderate in size, so that it could show how well it could perform its work, and at how reasonable a price it could supply the electric light to the public. If this were done, they would be able to show that the generating system was the best; and that it must be adopted by any company who hoped to work a reasonable area thoroughly. Let them not, however, in the early days of electric lighting, have such competition as would prevent them doing the work on terms that would make it possible for them to compete with gas. Above everything, he desired that the electric lighting of London should not be spoilt by concessions to companies which would enable them to take simply the good places—although they would not be able to do it thoroughly—and leave to others the lighting of large portions of London which would not be so profitable. The learned Counsel then proceeded to insist that the direct supply was the best; and also that it was capable of being used for motive power as well as for lighting. It was a method, too, by which they could avoid the danger of instantaneous extinction if anything went wrong. This, he urged, was of paramount importance when they were considering the question of lighting theatres and other large buildings such as were to be found in London. He then contrasted this with the possible danger of the transformer system, with its high potential. Returning to the general question, he said the Chelsea Company were bold enough to take an Order under the Act of 1882; but it was then practically impossible to supply electricity to London, owing to the stringent conditions placed on the suppliers. The Chelsea authorities then seemed to think that the best thing for the consumers was to have as many competitors for electric lighting as possible, so that they might run one against another; but this was a mistake, as being inimical to the securing of a good, steady, satisfactory supply of lighting for the inhabitants. In conclusion, he said he hoped the inquiry would result in granting the Orders he asked for.

Mr. *B. E. Crompton* was then called, and, in answer to Mr. MOULTON, stated that he was Managing Director to Messrs. Crompton and Co., Limited, and had devoted a great deal of his time to designing installations for central stations. He had designed the installation for the Hanover Square district for the Edison and Swan Company in 1882, and was entrusted with the designing and the carrying out of the large central station of the Imperial Continental Gas Association at Vienna, which was arranged for the supply of 13,000 or 14,000 lights. For some time he had been engaged at the Kensington station, where there was now plant sufficient to supply about 5200 lamps; it having increased up to this point very gradually from 300 lamps. The battery system gave absolute security to the public and the engineers in charge of the installation. The evidence which had been obtained as to the use of the electric light by the storeage system was such that all other systems of light had been dispensed with. In his opinion, the value of storeage batteries for public supply was very great. The nature of the demand in London varied very much. Residential London was a very large share of the area; but the light required there was small during a great part of the day.

Mr. MOULTON: What is the cheapest mode of supplying house-to-house lighting in London?

Witness: I have made careful calculations of the area of Kensington and Knightsbridge, which is about a square mile, and I find there is no advantage in departing from the direct supply—I mean the ordinary three-wire system, used in co-operation with storeage.

In further examination, witness said the transformer system was more expensive in regard to material and machinery than the direct system, in which there was a great saving in the number of men employed and in the wear and tear of plant. There was no trouble with the accumulators, so far as he knew, in Vienna, where there was a large number of storeage batteries. The evidence gained from America and Berlin was in favour of subdividing the units. Variations of potential were bad things for lamps. As to leakage, there was some difficulty in making joints to the customers' houses where there was a large main perfectly straight, and there must be some expansion of joints likely to introduce complexities. If the leak developed, in such cases no one could tell exactly what would happen. He thought there would be a momentary enormous rush of current, and that there would be a disruption, discharging and scattering copper about, much as they found when there was a large discharge of accumulators. Under such circumstances, no one could tell how far the flame would extend. A portion of the flame would be sufficient to destroy not only one, but half-a-dozen adjoining cables.

Mr. LOYD asked if he might be allowed to put in a report as to the electric lighting in Rome as an appendix to the report of the Board of Trade.

Mr. MOULTON objected, not having seen it.

As the report in question was upon a system which had not been carried out, the Inspector declined to admit it.

SEVENTH DAY—SATURDAY, APRIL 13.

The examination of Mr. *R. E. Crompton* was continued by Mr. MOULTON; and the witness, in answer to the question whether as an electrician he thought that underground mains for high-tension current could be relied upon, said the difficulties to be met with in carrying out underground mains for electrical energy were increased in proportion to the E.M.H. in the main. Whilst in America these difficulties were dealt with satisfactorily so long as the electrical pressure did not exceed 140 when employed with Edison's three-wire system; but the difficulties with high pressure, rising to 1000 volts, such as was used in the Westinghouse system, had not been satisfactorily dealt with.

Cross-examined by Mr. PEMBER, witness said he had not been in America.

Mr. PEMBER: You may perhaps know that there are hundreds of miles of mains in America where arc lights are worked with lots of joints on them on the 2000-volt pressure?

Witness: I am not aware that they have been dealt with satisfactorily. But there is an official document which states the reverse.

What do you mean—that they do not work satisfactorily?—The gentlemen report that the cost of keeping up is so great that the system does not pay a dividend. He had heard from Mr. Ferranti that his system was working at Nancy; but whilst that evidence pointed to satisfactory working at 2000-volt pressure, his (witness's) experience showed that the troubles did not commence until some time after the work had begun. But assuredly the insulation did break down. The result of a leakage would be a burn out. Of course if there were a system of double fuses, such a burn out as he suggested need not be feared. His experience of the transformer system was that of a contractor who employed both systems, as he wished to keep his works full of machinery in order that he might be able to meet the public requirements. As to the relative merits of the alternating and direct systems for the lighting of towns, there was no doubt that the alternating system had great merits for scattered districts, for which he should unhesitatingly employ it. But for the peculiar requirements of a thickly-populated place like London, with its varying demands for lighting, he considered it necessary to have the direct system with storeage. He did not agree with Mr. Ferranti as to the amount of coal required; and his (witness's) experience was based upon calculations as to the number of lamps required and the hours they would have to be burning. It was not at all likely that the lamps would have to be burning 10 hours a day at any period of the year. The average would be under 2 hours a day. Had the Grosvenor Gallery station been supplying light for 10 hours a day, it would have earned its capital over and over again. With regard to the commercial aspect of the question, the number of hours the lamps were burning was the most important of all. His calculation as to the consumption of coal was based on the supposition that the lamps would be burning less than 2 hours a day. The case of burning out he referred to was an accident of the direct system. A man put a plug into the wrong part—he plugged the wrong circuit, with the consequence that, although protected in the usual way with a margin of 20 per cent., there was a great deal of copper thrown about. It was on the dynamo side of the fuse. It occurred at Vienna about two years ago.

Mr. PEMBER: Are you prepared to say that the current went through the fuse at the moment?

Witness: Certainly; it could not go any other way.

You have said that you had unfortunately been present at burns out?—Yes. I have had burns out when experimenting at my own works, and I have seen their destructive effects. These leaks invariably take place in the presence of moisture. The leak is of an electrilitic nature, and as a consequence the copper near the leak is always attacked.

This experience of yours has not been with concentric mains?—No; but it could occur with concentric mains.

Any leak in our system, Mr. Ferranti says, would be in the nature of an explosion?—That is his opinion; it is not mine.

In reply to Mr. C. A. CRIPPS, witness said that he thought the question of safety was in proportion to the pressure of volts—a reduction in volt pressure would reduce the probability of danger. The best generating unit was about 200-horse power. Under the system of the Metropolitan Company, with careful management there would be very little difficulty as to noise, smoke, or vibration—in fact, practically no vibration would be felt. A 1000-volts pressure would be safe if it were kept quite separate from the houses. He could not, as an electrical engineer, give an absolute opinion as to whether or not a 1000-volts pressure was safe to life. As to the quantity of coal required, his actual experience was that 19 tons per day would be necessary for 100,000 lights.

Mr. CRIPPS: What is the candle power of the lamps of which you are speaking?

Witness: The unit of 10 candles. With reference to the comparative cost of the accumulator and direct systems, witness contended that besides the cost of the accumulator and the engine in the former system, all the distributing plant had to be made with the view to its being always ready to meet the greatest demand, which he asserted was of very short duration. Whereas the generating plant must be made equal to the greatest demand, that was not so in the direct system.

Mr. CRIPPS: Take a 100,000-light installation. What accumulator power do you provide?

Witness: If the generating plant cost £100,000, the accumulator plant would cost rather less than £20,000.

I mean for 100,000 lights?—It would be £200,000 against £40,000.

For how many hours does that give you accumulating power?—For all the time that I consider necessary.

But what is that?—About one-third of the total daily demand.

In answer to further questions, witness said that half a minute's extinction would be enough to cause a panic in a theatre; and if there were a breakdown in one of the engines, that would cause an extinction lasting half a minute. He did not think they could depend upon having a sufficient intimation of such a breakdown as would enable them to provide against it. The danger would be obviated if they could have the engines running parallel. There was a great destruction of lamps on the transformer system, from leakage which did not occur with the other system. In a case into which he had inquired, all the lamps were destroyed in a house one evening. The alternating system, especially with the feeder attached to it, was much more complicated than the direct system. The feeding and network were very complicated matters. The distributing-mains of the direct would be a little more expensive than those of the alternating system. In the direct system, the whole cost per mile of distributing-mains, including everything, varied from £900 to £1700. He had laid 900 yards of main at a figure which worked out at the former sum. In some cases it had gone to £2000; but in others he had cut it down to half the amount.

Major MARINDIN: Half would be £1000, not £900.

Witness: I have laid 4 miles in Kensington; and I am giving you the cost of a fairly representative portion of it.

Mr. CRIPPS: That is on the low-pressure system.

Witness: Yes. I am speaking of the main laid in Palace Gardens, which is 900 yards, and it is a straightforward job. His opinion was that

competition was not advisable if one company did its work fairly well, for it would necessitate the laying of two yards of main instead of one.

Does it not strike you that the people who fear competition would be forced out of the market if open competition were allowed to prevail?—No. I believe the competition suggested would be economically wrong. I have no objection to competition punitively if the other company does not fulfil its duties. Competition may be necessary in the public interest when it is introduced to bring a company up to its duties.

But is there any difficulty in the way of another company being allowed to compete in the same area?—No.

Mr. SHIRESS WILL: Upon what do you base your condemnation of the alternating-current system—is it upon experiments only or upon experience of its working?

Witness: I base my condemnation of it for use in London upon the fact that it has never been successfully worked under a system of overhead wires, either in America or in England; and further because I believe that the difficulties of placing the wires underground will be very great, and will considerably increase the expenses. I have satisfied myself that where it has been worked in England with overhead wires, it has been very unsatisfactory.

You have not had actual experience as an electrical engineer of any works conducted under the alternating system?—No; I have only had second-hand experience.

Examined by Mr. WALLACE, witness stated that the only subways put down by a local authority of which he was aware were one in the City and in Kensington. He did not know that any local authority had proposed the joint use of such subways. It was common to all systems that the nearer the houses or places to be supplied were to the stations, the better would be the supply. That was especially so in the low-tension system. The system proposed to be used with batteries was one with storeage. But the system to which he gave the preference was one in which the batteries were not used purely for storeage, but for regulating purposes and in cases of necessity, for storeage, and also during the maximum demand. The plant would thus be used to the utmost advantage.

Cross-examined by Mr. HEWITT, on behalf of the Kensington Vestry, witness said that he objected to bringing the mains of his Company into the same conduit as that of the mains of other companies.

Mr. HEWITT: You are aware that there were six companies competing in Kensington?

Witness: Yes.

And that there are four now?—Yes.

Would it be necessary for the parochial authorities to lay down a subway to accommodate all these companies?—In my opinion there is not at present enough known of the subject to allow of a subway being put down. I do not think the Vestry would put one down.

But do you think it would be necessary to put down a subway to provide for these companies if you are going to have open competition?—Certainly.

Do you think it would be practicable?—I do not think it would be practicable in the High Street, Kensington, looking to the small space there available.

Re-examined by Mr. MOULTON, witness said he had endeavoured to find out regular cases where the alternating system had been worked by dynamos in parallel; but he had not succeeded in discovering any. He did not think that fuses could be relied upon for safety; for in spite of fuses he had witnessed burns out.

In answer to Captain CARDEW, witness replied that there was no doubt that electrilitic action did take place with the alternating current. From what had been lately ascertained, he thought that the electrilitic action with alternating currents was serious.

Mr. *Frank King*, Chief Engineer of the Electrical Power Storeage Company, Limited, examined by Mr. MOULTON, said he had given much attention both to the use and manufacture of storeage batteries. He had erected, and was erecting batteries and automatic distribution apparatus in the Chelsea district. The Company had now one fully equipped centre; one in process of equipment; and a further one had been obtained.

Mr. MOULTON: What is the supply obtainable from such a storeage station?

Witness: It is capable of supplying 2000 10-candle power lamps.

What is the method adopted there?—The batteries are separated into two distinct halves. Each half is charged in series from the generating station. Whilst the charge is proceeding to one half, the other half is supplying what the lamps may require. Batteries could not be both on the charge and discharge at the same time. The pressure on the charging-main was 100 volts. The charge depended upon the number of stations and series. The voltage to charge each one was 500, and to charge three it would be 1500. The charge was not broken into in any way except at the battery-station. That arrangement was sufficient to maintain the potential throughout the network which went into each station. The network could be all kept together. To that arrangement a direct supply could be added; and it was intended to make this addition if the demand for supply warranted it. The Company would use as an auxiliary a current from the dynamo machines. They commenced to erect the batteries in the Chelsea district a few weeks ago. One of them was now actually supplying light, and of the other two, one would be ready in about a month. The system was perfectly capable of performing the duties of the undertakers under the Provisional Order. For a proper and efficient supply of house-to-house lighting the direct supply, coupled with the use of storeage batteries, was by far the best system. In cost it would not exceed that of the transformer system; in quality of supply it would be much superior, for it enabled them to work their plant at the maximum efficiency and full load. In his opinion, the batteries could be fully relied upon to do such work as would be required in the Chelsea district, and to do it economically.

Cross-examined by Mr. GRAHAM, witness stated that he had been Chief Engineer to the Company for 2¼ years. That was the extent of his practical experience of the E.P.S. cells. He had had no experience of laying over a large area from E.P.S. cells, for there was no such experience. There was one generating-station in Chelsea; and there were three distributing stations undertaken for the compulsory area. It was proposed to discharge the whole of the distributing stations in series; and the voltage proposed was from 1500 to 2000. The charging which was to bear the tension of 2000 volts would be measured by about 1½ miles. He had had experience of the installation at Colchester, but that experience was not satisfactory as regarded the installation.

In answer to Mr. LYTTLETON, witness said he could not tell how many lights the Company were supplying—the number was increasing every day.

Cross-examined by Mr. SHIRESS WILL, witness stated that the Company's battery system would discharge more than 7 hours. There was a capacity for 10 hours; but ordinarily they were intended for 7 hours on the maximum number of lights.

Mr. SHIRESS WILL: Would you in winter have to discharge at the same time that you were charging?

Witness: It is not possible to obtain it at high tension.

According to that, no one can have more than 7 hours of light?—That does not follow. But you never have all the lights continuing on for 7 hours.

Let us take the extreme case of a long-continued fog. In the case of a fog continuing for over 7 hours, where will your system be?—You will be able to run the system for 10 hours by its ordinary capacity.

Is it a fact that your Company charges 10 per cent. for replacing the worn-out plates?—The Company will enter into a contract to charge 12½ per cent. for replacing worn-out material.

And do you charge the cost of the new plates to the consumer?—No.

Mr. WALLACE: How many batteries would you require at your substations for 5000 lights?

Witness: 1060 cells.

How many batteries of 53 cells would that be?—20 batteries of 53 cells.

Would it surprise you to hear something very different is done at Kensington?—Nothing would surprise me with regard to statements about the Kensington battery.

You admit it is an improvement upon Colchester?—Yes; but you must be just in regard to Colchester. That was about five years ago. Very few of the gentlemen here then knew anything more about the question than I did.

Has there been any material improvement in batteries during these five years?—Yes.

Are you aware that the light at Kensington has never been out more than once in three years?—I have heard it said so.

Have you prepared any plant for your station at Egerton Gardens?—Yes; but we have not put any down yet. We have not supplied any light to Egerton Gardens from the generating station.

Mr. MOULTON: At the time of the Colchester works, there was no other attempt to supply?

Witness: No.

Have you estimated at what cost per lamp running you could supply 100,000 lights?—It is £2 5s. per lamp running.

How many lamps would that be installed?—About 50 per cent. more lamps installed than the lamps running.

Is that the inclusive cost of mains, generating plant, batteries, and everything?—Yes, that includes the cost of everything.

What do you mean by 50 per cent.?—The lamps running would be two-thirds of the lamps installed. Therefore £2 5s. would be per 1½ lamps.

You allow for lamps running at the rate of 2 to every 3 installed?—Yes.

For an installation of 100,000 lights do you think that would be the average cost?—Yes.

Does that compare favourably as an over-all cost to that of any other system?—I cannot say about the transformer, but I should think it did.

Captain CARDEW: I should like to make it quite clear about the number of cells—is it not a fact that under the Chelsea system you have two distinct series of batteries?

Witness: Two distinct halves.

And each one must be capable of dealing with the whole demand?—No; the two halves are capable, when working together in parallel, to give the maximum supply until 10 o'clock at night.

That is why you only keep your maximum supply for over 7 hours?—Yes.

The inquiry was again adjourned.

ODESSA WATER-WORKS COMPANY, LIMITED.

The Ordinary General Meeting of this Company was held last Wednesday at the Cannon Street Hotel, E.C.—Sir PETER SPOKES in the chair.

The notice convening the meeting having been read, it was agreed to take as read the Directors' report for the year ending Dec. 31, the substance of which appeared in the JOURNAL last week (p. 777).

The CHAIRMAN, in moving the adoption of the report, alluded to the great loss the Board had sustained by the recent death of one of their number—Mr. F. J. Bladon. He then proceeded to make extended reference to the paragraph in the report which stated that the "balance standing to the credit of revenue account on Dec. 31 amounted to £45,959, of which £11,945 was in respect of the year 1888. The disposition of this balance had exercised the minds of the Directors very much; and after considering several legal decisions in analogous cases, they passed a number of resolutions, by which, in effect, they recommended the distribution of a dividend of £1 per share in respect of the 'A' shares, by the issue of bonds bearing interest at 5 per cent., and repayable at par by annual drawings extending over a period of 30 years." He said he hoped the report and accounts would be regarded with satisfaction, for although the proposed dividend was not a cash dividend, yet it was raised to the position of a charge upon the property and assets of the Company, carrying 5 per cent. interest with redemption at par; and it therefore became a marketable security. He did not hesitate to say that they were pleased with the most recent definition of the law with regard to the application to make provision for wasting assets; that there was now no difficulty in the way of the payment of a dividend without the provisional formation of a sinking fund for the replacement of the share capital of the Company at the expiration of the concession. There was a slight falling off in the water-rents; but a larger quantity of water had been pumped. The explanation of this apparent anomaly was that the quantity of water sold at the 7-kopeck rate was less than in 1887; while the quantity sold at the 3-kopeck rate was in excess of 1887. Concerning the condition of the Company's plant, he observed that the boilers at the Dniester pumping station showed indication that they had done their work; and steps would have to be taken to replace them at an early date, so as to avoid the possibility of any mishap. They would be pleased to note an improvement in the value of the rouble, which had reduced their loss on remittances by more than £2000 as compared with 1887—viz., £853, against £2988. The Chairman then dealt with the question of raising £100,000 as a second charge on the property of the Company, having regard to the negotiations then pending with the Municipality of Odessa, which would involve a considerable addition to the capital of the Company, and also as to the allocation and division of this sum. In conclusion, he referred to the principal features of the balance-sheet.

Sir ARTHUR CLAY, Bart., seconded the motion.

A prolonged discussion then ensued, in which Mr. T. Bryce, Mr. Francis, and Mr. Goodsall took a prominent part.

The CHAIRMAN, in reply, said that from the tenour of Mr. Bryce's remarks, it seemed he was anxious to increase or make an addition to the sinking fund; but he (the Chairman) did not think the shareholders generally would sanction any such addition. The first resolution did not have any such bearing as had been suggested. Mr. Francis stated that he had been informed that there would be no market for the bonds, in regard to the £30,000 which it was proposed to allocate in respect of this dividend, until the whole of the £100,000 to which he (the Chairman) had made reference had been issued. He was mistaken. The fact was that, until the general public had had an opportunity of subscribing for

the balance, or some portion of the balance, of this £100,000, the Stock Exchange would not grant a quotation in respect of the £30,000.

After further discussion the report was adopted.

It was next decided to hold the meetings of the Company half-yearly instead of annually.

The retiring Directors and Auditors having been re-elected, a vote of thanks to the Board was passed, and the proceedings terminated.

MANCHESTER CORPORATION WATER SUPPLY.

COMMITTEE'S REPORT—PROGRESS OF THE THIRLMERE WORKS.

The Water Committee of the Manchester City Council have issued their annual report and financial statement; and they will be presented at the meeting of the Council to-morrow. It is recommended that a public water-rate of 3d. in the pound and a domestic water-rate of 9d. in the pound be levied for the year commencing on April 1. The amount of estimated available rates outstanding on March 31, out of a gross sum of £56,606, was £42 18s.; and of rentals £106, out of a gross sum of £156,259. During the year 40,077 fittings have been submitted for examination, and, upon being tested, 36,523 have been passed and stamped; and on subsequent inspection such fittings as have been fixed within the district supplied with water by the Committee have been found to successfully withstand the pressure of water. During the same period 324 meters have also been tested. The internal water-fittings in 30,471 houses, warehouses, and other premises have been inspected, and waste prevented, where necessary, by putting the fittings into proper repair, in accordance with the regulations of the Committee. During the year upwards of 8 miles of new iron piping have been laid in place of old piping on renewals account. Upwards of 7½ miles of iron piping, have been laid in extensions in various townships during the same period; and the Committee have made connections to 2320 additional houses and other premises by means of upwards of 2½ miles of lead piping, at an expense of £693. The whole of the reservoirs in Longdendale, and the service reservoirs in connection therewith from Godley to Prestwich, have been maintained in good condition, no special work having been required to be done. During the year, 1527 lineal yards of spring watercourse have been repaired or re-lined with masonry, and widened where necessary. The Committee report as follows on the progress made and the present position of the works in connection with the Thirlmere scheme:—Contract No. 1: Messrs. Morrison and Mason, contractors. Date of contract, May 6, 1887; length, 7 miles 174 yards; amount, £129,972. The length of tunnelling in this contract is 10,112 yards; and of this 7535 yards have been driven. The work in the three long tunnels stands as follows—viz., Dunmail Raise tunnel, 3429 yards driven out of a total of 5156 yards; Nab Scar tunnel, 1419 yards, was driven through on Feb. 20 last; Moordowe tunnel, 2199 yards out of a total of 3040 yards. The cut and cover portion of the aqueduct through Rydal Park is practically completed. The value of the work done amounts to £72,757. The contractors have paid £7042 on account of the plant and materials taken over from Messrs. Vernon and Co.'s contract, out of a total of £11,088. Including the work done on this contract by Messrs. Vernon and Co., the total value of work executed is £91,209. Contract No. 3: Messrs. Morrison and Mason, contractors. Date of contract, April 18, 1888; length, 6 miles 1059 yards; amount, £102,315. The length of tunnelling on this contract is 3897 yards, of which 793 yards have been driven; and the driving is now going on at many places. About 1700 yards of cut and cover have been completed out of a length of 5529 yards; and a considerable extent of excavation is opened out. The value of work done up to the present time amounts to £21,803. The works are now in full operation. Contract No. 2: The weight of cast-iron pipes delivered by Messrs. Macfarlane, Strang, and Co., Limited, and by the Staveley Coal and Iron Company, Limited, under their respective contracts, is 42,320 tons out of a total of 51,000 tons, equal to a length of about 36 miles out of a total of 45 miles. In addition to this weight, 1363 tons of irregular pipes have been delivered. The payments made to these firms amount to £182,757, out of £235,000, which is the approximate sum of their contracts. The following contracts for the aqueduct and other works have been let since the last annual report:—Contract No. 4: Mr. T. W. Chester, contractor. Date of contract, July 12, 1888; length, 15 miles 638 yards; amount, £143,269. The value of work done on this contract amounts to £10,458, and consists of tunnelling and cut and cover. The contractor has not yet completed his arrangements for carrying on the works at full speed. Contract No. 5: Messrs. M'Crea and M'Farland, contractors. Date of contract, Aug. 25, 1888; length, 16 miles 480 yards; amount, £141,813. The value of work done on this contract amounts to about £8000. The contractors have not yet delivered all the plant required for the work; and the progress so far made is therefore but small. Contract No. 6: Messrs. John Aird and Son, contractors. Date of contract, Dec. 5, 1888; length, 14 miles 1404 yards; amount, £163,745. Large quantities of plant have been delivered; and both tunnelling and cut and cover are in progress. The preparations made by the contractors will enable the work to be carried on rapidly. Contract No. 9: Prestwich new reservoir, Messrs. Kirk, Knight, and Co., contractors. Date of contract, Dec. 3, 1888; amount, £23,297. The contractors have delivered much of their plant, and are proceeding with vigour in the execution of the work; nearly £2000 worth having been already completed. Contract A: Ironwork required in connection with the cut and cover portion of the aqueduct. Messrs. Cochrane and Co., contractors; amount, £16,862. Good progress is being made in the preparation of the ironwork; and some of it is now ready for delivery. Contract B: Cast-iron pipes of various diameters in connection with the main aqueduct for cleansing and waste, &c., Messrs Cochrane and Co., contractors; amount, £7852. Contract C: Large valves for main aqueduct, Messrs. Blakeborough and Sons, contractors; amount, £5641. Contracts B and C have only recently been let; and contract No. 7, for a further length of aqueduct, will shortly be decided.

THE PUBLIC LIGHTING OF IPSWICH.—The question of improving the lighting of the streets was discussed at some length at the meeting of the Ipswich Town Council last Saturday week, on the presentation of a report upon the subject by the Paving and Lighting Committee. This stated that, assuming the gas to be charged at the reduced price of 2s. 10d. per 1000 cubic feet, and that the present discount of 12½ per cent. was continued, to change the burners in the street lamps consuming 3½ cubic feet per hour to 5-feet ones would involve an increased cost to the ratepayers of £265 per annum. Having carefully considered the matter, the Committee were unanimously of opinion that it was not desirable to pass a general resolution directing that every one of the public lamps should be made to consume not less than 5 feet of gas per hour, regardless of their situation, proximity to other lamps, &c.; but with the view of improving the lighting of the streets in an intelligent and economical manner, they recommended that they be authorized to spend the sum of £150, either in altering the position of existing lamps, or providing additional lamps, or in increasing the consumption of gas, where inspection showed improvements to be required. The report was agreed to.

THE NEW WORKS OF THE BELFAST WATER BOARD.

The scheme which the Belfast Water Commissioners have at present in hand for augmenting the water supply will soon be completed; and we are now in a position to give a short account of the new works. The storeage reservoir is formed in a natural basin, adjoining Stonyford. By means of an embankment, about one-third of the entire drainage area is intercepted; and the other two-thirds of the water will be brought in by the Leathamstown conduit, which is about two miles long and 4 to 6 feet in diameter. This is formed of brickwork for about half the distance, whilst the remainder consists of iron pipes. Another supply is provided, *viâ* Stonyford. The streams are collected by conduits varying from 3 feet to 4ft. 6in. in diameter. The Stonyford reservoir is formed by an embankment about 1100 yards in length; the average height above the ordinary surface of the ground being 20 feet. Along the entire length of this embankment, a puddle trench is formed down into the water by material varying from 25 to 35 feet deep; and this was subsequently filled with puddle, or prepared clay. The means to be adopted in dealing with the water from the reservoir will be by a 6-feet brick outlet culvert formed through the solid ground. It afterwards passes under the embankment to what is known as the "tailby" weir; and by an arrangement of valves on the masonry tower in the inside of the reservoir, the water can be thrown off at any length over a range of 30 feet. At the "tailby" it is further controlled by means of valves and weir; so that a quantity up to 8 million gallons a day can be discharged through the Legmore conduit, which, it may be stated, is 8 miles long, and connects Stonyford reservoir with the service reservoir near Danmurry. The former reservoir when filled will have an area at the top water-level of almost 160 acres, and will be capable of storing upwards of 700 million gallons, which is about equal to four months of the present daily consumption in Belfast. The works, including the storeage reservoir and the Leathamstown and Stonyford conduits, are what are known as contract No. 1. The work was originally let to a Liverpool firm of contractors in the year 1896; and after twelve months' experience, the Commissioners determined that, in order to have it completed within the stipulated time required by the Act of Parliament, they would take the works into their own hands, which they did in August, 1887. Since that time the works have progressed rapidly; and now the Leathamstown and Stonyford conduits are completed and in full working order, and the main work at the reservoir is well advanced towards completion—the embankments being brought up to the top bank level for over four-fifths of its length. In fact, it is expected that this portion of the works will be almost completed by the beginning of the coming autumn. At present there are almost 300 hands at work on this contract; whilst at times, since the Commissioners have undertaken the work, more than 500 have been employed daily. With regard to what is called contract No. 2, the Legmore conduit from the Stonyford reservoir to the service reservoir at Legmore is 8 miles long; and for about three-fourths of its length is formed with 3-feet brickwork—the other quarter consisting of iron pipes, varying from 21 to 30 inches in diameter at the several valleys met with. This conduit is almost completed; and in its present state is capable of taking about 5 million gallons of water per day into the service reservoir, should it be required for the supply of water for the city. The service reservoir at Legmore is formed in a deep valley near Derriaghy by an embankment about 8 chains long, with a depth of about 60 feet in its deepest part, and is constructed in a similar way to the Stonyford embankment; having a puddle trench and well in the centre, and earth slopes and stone face on the water side. At this reservoir is an arrangement of straining wells for the purpose of roughly straining the water sent from Stonyford. These wells are so constructed that, by an arrangement of valves and pipes, the supply of water to the city can be drawn either directly from the reservoir or supplied from the conduit without passing through the reservoir; so that should any repairs be required in this reservoir, no interruption to the Belfast supply need occur. Messrs. Fitzpatrick Bros.—a local firm of contractors—have charge of this section of the works, which it is expected will be completed and ready for use early in the summer. A line of high-pressure pipes, 18 inches in diameter, has been laid to connect the Legmore service reservoir with the town main; and from this supply a pressure of over 300 feet will be available in the city. The entire works, both at Stonyford and Legmore, are directed and supervised by the Resident Engineer, Mr. F. W. M'Cullough, Assoc. M. Inst. C.E., controlled by Mr. L. L. Macassey, M. Inst. C.E., the Chief Engineer to the Water Trust.

THE ACTION OF WATER ON LEAD PIPES.

The annual report of the Medical Officer of the Local Government Board has recently been issued; and it embodies a memorandum by Mr. W. H. Power, on lead-poisoning at Sheffield, Dronfield, Huddersfield, and Mirfield. Mr. Power alludes chiefly to lead-poisoning at Sheffield, and refers at length to the report made on the subject by Dr. Sinclair White, when Medical Officer of Health, and to the investigations carried on by him previous to his report being issued. He points out that the soft moorland water which has been delivered to Sheffield for half a century, suddenly caused so much lead-poisoning in 1885 as to arrest the attention of the Medical Officer of Health. It was found that only the water supplied from the high-service reservoirs was deleterious; the water from the low-service reservoirs being practically innocuous. It was also discovered that the plumbo-solvency—that is to say, the power of the water to act upon lead—was affected by various conditions; among them being time, temperature, water pressure, and the season of the year. It was ascertained that the high-service water contained free acid; and the general opinion of various eminent chemists throughout the country was that that acid was almost necessarily sulphuric. Dr. White, however, hesitated to adopt that view; and Mr. Power endorses his hesitancy—observing that ulmic and humic acid, associated with decomposition of wood, leaves, peat, and vegetable mould, deserve to be thought of in this connection, although they are generally but little understood. Dr. White demonstrated that the lead taken up by the water could be abstracted from it by simply passing the water through various (chiefly carbon) filters, and could also be prevented from taking up the lead by the same means. Further, it was demonstrated that the high-level water could be deprived of its solvent action on lead by keeping it for a few hours in contact with freshly-broken Derbyshire limestone.

Mr. Power, while acknowledging that Dr. Sinclair White's report was an excellent one, says it does not greatly advance present knowledge of the cause of the dangerous plumbo-solvency of natural waters. Nothing is shown as to the means of preventing water from acquiring plumbo-solvent ability. Dr. White had, by successive steps, ascertained not only that the high-level water (which acted freely on lead) contained more free acid than the low-level water (which practically did not act on lead), but also that different streams—all of them tributary to the high-level reservoirs—varied greatly as to the amount of free acid that their waters contained. Here we were met by a new series of considerations. It would, for example, be of much interest to know for certain whether the plumbo-solvent action of the streams tributary to the high-level reservoirs varied

directly with the amount of free acid present in their waters. Whether or not the streams varied in this respect, it would be profitable to learn of other respects (if any) in which they may have differed, chemically or otherwise, from each other, or from the water of the low-level reservoirs. What was wanted was to ascertain where the plumbo-solvent came from, and how its production could be hindered. For almost nothing was known as to the cause or causes of the dangerous action on lead of natural waters, and next to nothing as to the means by which natural water can be prevented from acquiring the property of thus acting on lead. There was a general admission that (1) natural waters most apt to act on lead were among the purest, and oftentimes the most highly oxygenated, as, for instance, the very soft waters of certain lakes and upland streams; and (2) natural waters least apt to so act were those containing abundance of earthy salts, especially abundance of lime—*i.e.*, hard waters, as the deep-well waters of various geological strata. Nevertheless it was also admitted that in each class there were waters which departed from the rule of their class. Mr. Power thinks there is no way of getting at a better understanding of the facts except by a process of differential examination of selected waters which shall have been proved, on the one hand, to possess plumbo-solvent properties, and which, on the other hand, shall be found to behave in different manner towards one and another test. Reference is then made by Mr. Power to the observations recorded by Mr. Crookes, and to the investigations of Drs. Odling and Tidy. In this connection, he says that soft waters of moorland origin, first accumulated in lakes and reservoirs, and then delivered to populations, appeared from the point of view of the experimental chemist classifiable under three heads—(a) soft waters found rarely to act on lead, and never to on appreciable or dangerous extent; (b) soft waters which acted more or less on lead, but whose action diminished day by day until, in a comparatively short time, it ceased altogether; and (c) soft waters acting freely on lead, and whose action did not always diminish with lapse of time, but may tend to increase, or to go on almost indefinitely. But it was important to note that now and again one and the same water would have to be classed differently according as it was taken for examination from the locality of its storeage or from the water-mains at some point of its distribution to a population. For instance, the water supply of Glasgow, when samples are taken from Loch Katrine, is found to possess very vigorous and sustained action on lead, whereas the same water as delivered from the town mains has been found to have very insignificant action on lead pipes; and, as a matter of fact, lead-poisoning by the water-service is not heard of in Glasgow. How far and how often the reverse was the case—that a water having in its locality of storeage very slight and temporary action on lead can acquire during the subsequent conditions (the retention, pressure, &c.), of its presence in the pipes of a town service greater and more sustained plumbo-solvent power—was among the matters that were not yet known. Nor was there any knowledge whether there existed soft waters not ordinarily possessed either at their places of origin or distribution of any demonstrable power to act on lead, which could exceptionally acquire at one or both places ability for pronounced action of this sort; for the experience of Glasgow could not in the present state of knowledge, and with the instance of Sheffield in view, be held to disprove the possibility that a water which, like Loch Katrine, had commonly in its locality of storeage vigorous and sustained action on lead, may on occasion retain or recover that power after its delivery in a town, with the result that lead-poisoning—aforetime rare or unknown among the inhabitants—shall become of a sudden common and widespread. Mr. Power calls attention to the fact that Glasgow is 25 miles from Loch Katrine, and that the time occupied by the water passing thence to the city is ten or twelve hours. As the opportunity thus afforded for modification of the water is considerable, the question arises whether the observed diminution or abolition of its plumbo-solvent property is due (as is believed) to the chemical action of the sandstone and limestone conduit through which it flows, or to other and obscure influences.

Mr. Power shows, however, that there must be something more than the material used in the construction of the conduit; for in the case of the Loch Katrine water, a loss of its plumbo-solvent ability is discernible after it has flowed a few miles from the Lake by its natural outlet; and he asks whether a mere delay of soft water—by mechanical means affording time and opportunity for filtration, for exposure of the water to light and air on weirs or in shallow channels—in its passage from its gathering-ground to its destination in a town, goes far to rob it of any plumbo-solvent property it may originally have possessed? It might be that this was so, and in that case Glasgow had nothing to apprehend from unknown changes in the condition of its water service. And if that was the reason of the security always to be possessed by Glasgow, the conditions of security there existing might be capable (if only they could be known) of being imitated elsewhere, with the result that no more would be heard of lead-poisoning by the water supplies of Sheffield, Huddersfield, or other places that possessed storeage reservoirs of moorland water now in dangerously close relation with their domestic services. Remedial processes have been adopted in certain towns by which lead-poisoning has been mitigated or arrested. These were chiefly chemical in their action, but they involved delay in the passage of the water from its gathering-ground to the service-pipes; and Mr. Power thinks that perhaps not sufficient influence has been attached to the delay thus incidentally produced. Might it not, he asks, have been owing to this delay and its own proper consequences, as much as to direct chemical action, that these towns have come to have water devoid of dangerous plumbo-solvent properties? Nothing but profit could arise from inquiry as to how far the improvement actually effected ought to be placed to the credit of special contrivances professing to act chemically, and how far to physical and other conditions involved in the measures successfully adopted. Especially was it desirable to ascertain the effect of mere filtration of soft moorland water in cases where this precaution has been adopted. In a word, the precise physical circumstances of all public soft-water supplies, deserved in this connection more exact study than had yet been bestowed on them.

SINGAPORE GAS COMPANY, LIMITED.—The report of the Directors of this Company for the half year ending Dec. 31, 1888, which will be presented to the shareholders at the ordinary general meeting to-day, states that towards the end of the half year orders were received from the Municipal Commissioners for upwards of 100 additional public lamps, of which 38 have been lighted, and the remainder will be erected before the expiration of the present half year. The great advance in the rate of freight to the East has added considerably to the cost of coal. The sales of residuals have been good, and the collections satisfactory. The manufacturing plant, mains, services, and buildings have been maintained in good order. The Manager reports that a considerable amount of work has been carried out in completing the excavation, laying the foundation, and erecting the new gasholder and tank. After charging the profit and loss account with the usual writings off, there remains a net available balance of £2532 17s. Out of this sum the Directors recommend the declaration of a dividend of 7½ per cent. per annum, less income-tax; the balance of £259 11s. 7d. to be carried forward.

NOTES FROM SCOTLAND.

(FROM OUR EDINBURGH CORRESPONDENT.)

EDINBURGH, *Saturday*.

The dinner of the Edinburgh and Leith Gas Commissioners, to which I referred last week, came off on Tuesday night, in the Royal Hotel, and was a most pleasant, though not perhaps in all respects a profitable, gathering. It was intended as a sort of *gaudeamus*, at which the Commissioners, after having mastered their new duties, should meet and congratulate each other, and to which also representatives of their former antagonists, the Gas Companies, were invited, in order that the "hatchet" might be formally put underground. Both objects were very successfully accomplished; so much so, that towards the end, speaker after speaker reiterated the desire that the gathering should be regarded as a "first annual" one. Lord Provost Boyd, who is never much of a controversialist, was in an exceedingly happy mood; and under his genial chairmanship, compliments flowed as freely as the wine. It was a happy thought, and a courteous recognition of distinguished services, to invite Lord Balfour of Burleigh, who presided over the 1887 Committee, and Lord Ravensworth, who was Chairman of the 1888 Committee, to dine with the parties who fought such a fierce fight before them. Lord Balfour is at present in Scotland on a Parliamentary Commission; and he was present, and proved quite a host. Lord Ravensworth wrote expressing regret at his inability to be present. The business was purely of a festive nature; but one or two of the remarks may be interesting. Bailie Archibald, the common-sense Magistrate hailing from Leith, it may be expected, gave but cold comfort to promoters of electric or other forms of lighting, when, commenting on the combination of Edinburgh and Leith upon the question of water and gas, he said that, having purchased the lighting power of Edinburgh and Leith, if electricity or any other mode of lighting should come in, the Corporations would take it up, they should take care not to allow any other Company to establish a monopoly to be bought up in future. Then there is valuable testimony to the faith which business men have in gas lighting, in the statement of Bailie Chalmers, of Leith, in proposing "The Edinburgh and Leith Gas Commissioners." He was, he said, a Director of one of the Companies taken over. He still believed in gas; and since being extinguished as a gas shareholder, he had purchased gas shares in London, for which he had to pay £250 for every £100 of stock. Then Mr. Councillor J. C. Dunlop, in proposing the "Old Gas Companies," said they must have been very able, far-seeing men in 1820, who, when gas was first discovered, had the courage and the pluck to invest their money in it. But they had in Edinburgh reaped their reward of 10 per cent. for 50 years, not to say anything of large bonuses. These remarks of Mr. Dunlop show the easy triumph which gas had, even in its early days, and throw a suggestive light upon the dire struggles of disappointed speculators, in modern times, to establish a more brilliant illuminant. Mr. Treasurer Clapperton suitably acknowledged the toast on behalf of the Old Edinburgh Company, and ex-Bailie Tawse on behalf of the old Edinburgh and Leith Company. The heads of the departments were all present, with the exception of Mr. Cockburn, the Collector. "The Engineers" were toasted; and Mr. Mitchell, of Edinburgh, and Mr. Linton, of Leith, briefly acknowledged the compliment. The Clerk, Mr. Jack, S.S.C., and Mr. Gibb, the Treasurer, returned thanks to the toast of their departments. Mr. Gibb made a very fine speech, testifying to the cordiality with which the staffs of the two Companies had come together, and the pleasant way in which they now worked. The Commissioners, he said, would be delighted to hear that there had been so little dissatisfaction. He had received invaluable assistance from his colleague, Mr. Cockburn; and he was glad to be able to say that his first angry word had yet to be spoken in the office in Waterloo Place. At a later stage of the proceedings, Lord Balfour paid Mr. Gibb the very high compliment of saying he had listened to his speech with pleasure; and if he habitually dealt with figures of the same complexity as those he put before the Committee, it was an astonishment to him that he was able to be present with them. He always had a lingering suspicion that those figures were not made less intricate, and less complex, for the purpose of enlightening the Committee; and that if it were not added, at any rate nothing was subtracted from the difficulty of understanding them. This wound up the proceedings; and I am sure everyone who was present on the occasion will echo the wish that the gathering should be made an annual one.

The Gas Committee of the Aberdeen Town Council on Wednesday had before them a report by Mr. Alex. Smith, the Gas Manager, upon the subject of new stoking machinery, by means of which a considerable saving would be effected in the manufacture of gas. It was estimated that the cost of the machinery would be about £6000; and the saving, if it were adopted, would be about £1526 per annum. It was agreed to have the report printed; and that the Committee should visit the works in connection with the matter. It was reported that a supply of suitable gas-burners had been secured, and that arrangements would be made for their sale to the public at a reduced rate.

Mr. William Blair, the Manager to the East Wemyss and Buckhaven (Fifeshire) Gas Company, has been appointed Manager of the Haddington Gas Company, to succeed Mr. James Robb, who resigns the post on the 1st prox., after holding it for upwards of forty years.

Negotiations have been in progress for some time between the Dundee Gas Commissioners and a Ratepayers' Association in Downfield—a suburb of Dundee—for the lighting of the village; and on Wednesday terms were come to. A Sub-Committee of the Commissioners on that day received a deputation of the ratepayers; and after discussing the matter, it was resolved that the ratepayers should furnish the lamps, and that the Commissioners should maintain, light, and extinguish them on condition that householders in Downfield paid for their domestic consumption at the rate of 1s. to 1s. 3d. per 1000 cubic feet above the price charged in Dundee. The acceptance of these terms by the ratepayers is an indication of the value which the inhabitants place upon lighting by gas. I doubt not the merits of oil lighting were considered by these long-headed Dundonians, and discarded as not being equal to gas even at 1s. per 1000 cubic feet dearer than it can be had from Dundee.

The Hon. James William Moncreiff, W.S., who recently retired from the clerkship of the Edinburgh and District Water Trust, was on Wednesday last presented by the Trustees with a pair of silver candelabra, the inscription on which stated that it was presented "on the occasion of his resignation of the office of Clerk to the Trustees, a position which he filled during the period of 17 years, with great ability and singular tact and courtesy." Mr. Moncreiff is the son of Lord Moncreiff, who recently resigned the office of Lord Justice Clerk. When he gave up the clerkship, the Trustees voted him a honorarium of 100 guineas; but as Lord Provost Boyd explained in making the presentation, Mr. Moncreiff preferred to have something which would hold in remembrance his connection with the Trust. In returning thanks for the gift, Mr. Moncreiff acknowledged that it was to his appointment as their Clerk that he owed his success. Bailie Archibald, of Leith, subsequently said that the gift was actuated by no party movement, but was the outcome of pure love and admiration for a man who did his duty honestly and well.

(FROM OUR GLASGOW CORRESPONDENT.)

GLASGOW, *Saturday*.

Almost as a matter of course, some of the speakers at the "informal" meeting of gas managers held in Glasgow this week, had something to say regarding the improved and improving condition of the residual products market. There is much room to be satisfied with the improvement that has been in progress, if the experience of the Glasgow Corporation Gas Committee may be regarded as indicating how the tide is running generally. In the last monthly statement made to the Sub-Committee on Finance, in respect of the revenue for the sale of residual products, it was reported by the Treasurer that it amounted on the 31st ult. to upwards of £51,000, whereas at the corresponding date last year the income from this source barely reached £39,000; so that there was an increased income of nearly £12,500 on the financial year, with two months still to run.

The same Sub-Committee have approved of a proposal to advance the salaries of two very zealous and efficient servants of the Gas Trust—namely, Mr. Hugh Scott, Chief Clerk in the General Manager's Department, and Mr. J. Robertson, Superintendent in the Pipe-Laying Department. In both cases the recommendation of the Sub-Committee is for an increase of £50 per annum. There is some talk of a proposal to advance the salary of one of the principal officers of the Gas Committee; but I am not at liberty to say anything further regarding this matter in the meantime.

At a recent meeting of the Works Sub-Committee of the Glasgow Gas Trust, there was under consideration a letter from the Deputy Town Clerk intimating that he had been instructed by the Magistrates' Committee to write and say that during some part of the week ending the 30th ult., the gas seemed to have been below the minimum authorized by the Town Council. The letter was remitted by the Sub-Committee to the Manager, with instructions to see that the minimum standard of illuminating power authorized should at all times be maintained. This standard, it may be remembered, was fixed at 22 candles. Even though the illuminating power does now and then fall below the standard authorized, the gas is certainly of very excellent quality; its luminosity being well brought out by the good burners which are so extensively used in Glasgow and the suburbs. From the Gas Examiner's weekly reports, which are publicly exposed in the Gas Office in Virginia Street, I have observed that the gas, in at least one instance, has again been set down at a lower point than 22 standard candles. Of course, that means the minimum illuminating power. Frequently, however, the maximum is set down at upwards of 23 and even 24 candles.

The contract for the supply of fire-clay bricks and fire-clay retorts to the Glasgow Corporation Gas Commissioners' works for the next financial year, commencing on June 1, has been let to Mr. J. Binnie, of Glasgow and Gartcosh. Messrs. Alexander Wright and Co., of London, and Messrs. R. Laidlaw and Son, of Edinburgh and Glasgow, have secured the order for the supply of meters during the ensuing year.

Recently the Police Commissioners of Clydebank have been considering the question of supplying gas to the consumers within the rateable area; and it was lately said that they had arranged for feuing some land on which to erect gas-works to supply gas to the western portion of the burgh known as Dalmuir. It has also been stated that negotiations were in progress with the Glasgow Gas Corporation for the extension of the gas-mains to Dalmuir, which already provides a supply of gas for Yoker and Clydebank proper, and that it was expected they would eventually be carried to a successful issue. As regards the Dalmuir portion of the burgh, there is no doubt that considerable dissatisfaction has lately been showing itself in reference to the price and quality of the gas supplied there. But even as it is, the gas consumers there are very much better off than they were a few years ago, as then they had no gas at all, and had to content themselves with oil-lamps. Within the period referred to, the mains of the Old Kilpatrick Gas Company have been extended to Dalmuir at very considerable expense. I think it is scarcely probable that the Glasgow gas-mains will also be extended to Dalmuir on the understanding that the price of the gas is to be continued at such a low rate as is being paid in Yoker and Clydebank.

It is reported that the present financial year of the Johnstone Gas Corporation promises to be more successful than any previous one, as it is confidently expected that the profits will amount to at least £1000.

Works in connection with the water-supply scheme for the Falkirk and Larbert district has begun in earnest at Carron Bridge, to the north of the town; and considerable progress has been made in the laying of the water-mains. In connection with this scheme, it may be mentioned that a local banker, acting on behalf of a financial firm, has offered to lend the Water Commissioners the sum of £50,000 at the moderate repayment of principal and interest of £3 12s. 6d. per cent.

At the last meeting of the Glasgow Corporation Water Commissioners, the Sub-Committee on Finance reported that the probable revenue and expenditure for the current year showed an estimated surplus of £23,115; and they recommended that this amount be carried to the credit of next year's account. There was further submitted an estimate of revenue and expenditure in connection with the Corporation water-works for the year from May 31, 1889, to May 31, 1890, based upon the assumption of the domestic water-rate within the municipality being continued at 7d. in the pound. The estimated expenditure, including £37,100 as interest on sinking fund, and £3116 of deficiency on river supply works revenue account, is £161,201; and the estimated revenue, £167,547—giving a surplus of £6346. It was agreed to recommend that the domestic water-rate be fixed at 7d. for consumers within the municipal boundaries, and 11d. in the pound for outside consumers; that the public water-rate be continued at 1d. in the pound; and that the table of rates and charges for supplies for other than domestic purposes should remain the same for the current year, but reducing the annual charge in the case of private taps in premises under £10 rental from 10s. to 7s. 6d. for each tap. After some conversation, it was agreed to delay fixing the domestic and other water-rates for next year; the Lord Provost remarking that it might be necessary to make some alterations.

The Secretary for Scotland, the Marquis of Lothian, has recently granted to the Police Commissioners of Motherwell a Provisional Order, empowering them to purchase the necessary land in connection with their schemes for increasing the water supply of the town.

A quiet tone has prevailed in the Glasgow pig-iron warrant market during most of the past week. Scotch warrants fluctuated in price between 44s. 9d. per ton cash on Wednesday and 44s. 2d. per ton, at which there were buyers at the close yesterday afternoon. Cleveland warrants at the close were quoted at 38s. 9d. per ton; and hematite iron at 48s. 10½d. per ton. Scotch special brands have been fairly steady. The number of blast-furnaces in actual operation is now 83, as compared with 87 at this time last year. An additional furnace has been blown in during the week to work on hematite. Stocks are gradually decreasing in extent.

All branches of the coal trade are characterized by a good tone; and prices are well maintained at late values. The demand keeps exceptionally good for firm qualities; and the same may now be said in reference to all classes of steam coal. Holders of cannel coal are very firm in their quotations.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *April* 27.

Sulphate of Ammonia.—There has been a fairly active inquiry all the week; and the demand seems to become rather more intensified, instead of slackening off, as is generally the case at this period of the year. But as the make is simultaneously becoming reduced, it must not be wondered at that prices are gradually hardening. At Hull, £12 is now being freely paid; at Leith, £11 17s. 6d. is the current price; while at Liverpool, quotations are simply nominal for want of supplies, and spot parcels have rarely been so scarce before. With the further advance of sugar, it is now taken simply as a matter of course that consumers of sulphate should display a little anxiety as regards future supplies; they evidently foreseeing some danger in the demand overtaking the production, especially during the summer months. The sowings of beet will undoubtedly be very large; and in the event of a wet season, sulphate will be considerably drawn upon, as it will probably have the preference over nitrate.

LONDON, *April* 27.

Tar Products are in steady demand, prices rather firmer, and deliveries more active since the holidays. With the reducing production, prices are not likely to fall off. Prices may be taken as follows:—Tar, 20s. to 25s. per ton. Benzol, 90 per cent., 3s. 2d. per gallon; 50 per cent., 2s. 2d. per gallon. Toluol, 1s. 5d. per gallon. Solvent naphtha, 1s. 2d. per gallon. Crude naphtha (30 per cent.), 1s. per gallon. Light oil, 3¼d. per gallon. Creosote, 2¼d. per gallon. Pitch, 20s. to 25s. per ton, according to position. Carbolic acid (crude), 3s. 9d. per gallon. Cresylic acid, 10d. per gallon. Tar salts, 17s. per ton. Anthracene (30 per cent.), "A" quality, 1s. 4d. per unit; "B," 1s. 1d. to 1s. 2d. per unit, according to quality.

Ammonia Products.—Sulphate of ammonia is quiet, and the price unaltered. Prices: Gas liquor (5° Twaddel), 8s. per ton, with a rise or fall of 1s. 6d. per degree. Sulphate of ammonia, £11 17s. 6d. to £12 per ton. Liquor ammonia, 2d. per lb. Carbonate of ammonia, from 3d. to 3¼d. per lb. Muriate of ammonia, brown, £19 per ton; white, £23 15s. per ton. Sal-ammoniac, £30 to £32 per ton.

REDUCTION IN THE PRICE OF GAS AT BRIGHOUSE.—At a recent meeting, the Brighouse Local Board decided to allow, from July 1 next, a discount of 6d. per 1000 cubic feet (instead of 5d.) on all accounts paid within three months.

FYLDE WATER COMPANY.—The Directors of this Company, in their 49th half-yearly report, submitted to the proprietors at their meeting last Wednesday, stated that the capital account had been increased during the half year by an expenditure of £397; bringing it up to £235,949. The revenue account showed that the water-rates and other receipts during the half year ended Feb. 28 (including £1623 9s. 3d., the balance brought forward) amounted to £12,433 15s. 5d., from which was deducted £538 13s. 6d., allowances for empty houses and bad debts; leaving £11,865 1s. 11d. After providing for interest on loans, working expenses, &c., a net balance of £7933 6s. 8d. was left for division. A dividend at the rate of 6¾ per cent. per annum will be paid; leaving £2088 to be carried forward. A resolution was passed authorizing the raising of an additional £10,000 by the issue of new consolidated "B" stock.

MONTE VIDEO WATER-WORKS COMPANY, LIMITED.—The tenth ordinary general meeting of this Company was held last Thursday, at Winchester House, E.C. Mr. F. S. Isaac presided; and, in moving the adoption of the report (an abstract of which was given in the JOURNAL last week) remarked that the dividend of 5 per cent. which the Directors recommended would, after placing £12,000 to the special reserve fund, allow about £1260 to be carried forward. The services had nearly doubled in number since the formation of the Company in 1879; being now 8018 as against 4449. They had received news from the other side showing that this year's increase continued. Since Dec. 31 last, the revenue had augmented by £951; and he believed it would continue to increase in a city so large as Monte Video. The Manager reported that he hoped the whole of the new works would be completed by July next. Mr. W. Wilson seconded the motion, which was carried unanimously. Some formal business was then transacted, and the proceedings terminated.

NORTHERN COAL TRADE.—There has been decidedly more activity in the coal trade of the North since the last report, and the holidays have made coal scarcer. Some heavy contracts for steam coals for Russia have been booked at prices varying from 9s. to 9s. 6d. per ton, free on board; and as the shipments to the Baltic will begin forthwith, there will be greater briskness in the trade for the next few weeks. For gas coal there are fair orders for export; but the price is a little lower, and from 7s. 6d. to 7s. 9d. may be given as the quotations now current. It is expected that some of the large contracts for British gas companies will soon come into the market. There is, however, great uncertainty as to the wages of the miners, beyond the middle of the year; and the companies which can previously stock coal would find it desirable to do so, as some sharp advance in wages is then probable. There is little change in the demand for other kinds of coal; but smithy coal is being largely shipped, and the best kinds command 8s. 6d. per ton. Household coal is depressed; the local demand now falling off rapidly with the warmer weather.

THE CONDITION OF THE ECCUP RESERVOIR OF THE LEEDS CORPORATION.—A meeting of the Water Committee of the Leeds Corporation was held on Friday last to discuss the condition of the Eccup reservoir, which matter has been referred to on several occasions in the JOURNAL. The Borough Engineer (Mr. T. Hewson, M. Inst. C.E.) reported that in January, when the reservoir was of the depth of 55½ feet, the leakage per 24 hours was 1,139,762 gallons; and now the depth had been reduced to 30 feet, the daily leakage was 607,193 gallons. Mr. Hewson's advice was that no attempt should be made to increase the contents of the reservoir without first adopting measures to prevent the leakage wearing away the puddle wall, or for stopping the leakage altogether. By carrying out his proposals, which would entail a maximum cost of £15,000, the leakage and the damage to the reservoir would be alike obviated. Briefly, his proposition is to carry a shallow puddle wall to the depth of the existing puddle wall, and to throw out from the end of it a wing trench to a similar depth. This work would occupy eighteen months. For this purpose the Eccup reservoir would have to be run dry, and water from the Washburn be carried by pipes across the reservoir to the valve-shaft of Blackmoor tunnel, and for that work the old conduit would be utilized. Mr. Hewson suggested that, in the interest of the ratepayers, the Committee should call in Mr. G. H. Hill, of Manchester, the Engineer to the Manchester Corporation for the Thirlmere scheme. This it was agreed to do; and it was decided that a copy of Mr. Hewson's report should be forwarded to Mr. Hill, that he should inspect the reservoir in company with Mr. Hewson, and then that his report should be presented to the Committee at a meeting to be specially called for its consideration.

THE ELECTRIC LIGHTING EXPERIMENT AT BARNET.—At the last meeting of the Barnet Local Board, the Lighting Committee reported, in regard to the account of the contractor for the electric lighting (Mr. Joel), which, as stated in the JOURNAL for the 9th inst., had been referred back to the Finance Committee for further consideration in connection with an allowance of 21s. 6d. off the total amount of the bill, as compensation for the defective lighting, that in their opinion this was not sufficient. They calculated that, as shown by the report of the expert who tested the lights, there was a deficiency of illuminating power amounting to about 1-16th; and, after discussing the matter, it was agreed by the Committee that this was the proper proportion to be taken off the account. On this being pointed out to Mr. Joel, he agreed to accept £90 in discharge of his claim; thus allowing a reduction of £5 17s. to the Board. The Committee recommended that the account should be paid. The report was adopted.

ELLAND LOCAL BOARD WATER SUPPLY.—Last Thursday, Major-General C. Phipps Carey, R.E., held an inquiry at Elland, on behalf of the Local Government Board, respecting an application by the Local Authority for powers to borrow £5000 for the purpose of constructing a new service reservoir within the district, and laying a new system of distribution-pipes. The district is supplied with water from the Halifax Corporation; but complaints have long been made by ratepayers in the upper part of Elland that the pressure is unequal to the demands, and the water supply therefore quite unsatisfactory. The town is growing chiefly on more elevated ground than the older part; and it is on this account that the supply has become inadequate. The proposed reservoir will hold 480,000 gallons; and according to a scheme prepared by Mr. G. H. Crowther, of Huddersfield, water will be conveyed thither from the Halifax Corporation mains, and then distributed over the district. Two ratepayers spoke against the scheme; but they admitted the need of some improved system.

IMPROVING FINANCIAL POSITION OF THE ROCHDALE WATER-WORKS.—The Water-Works Committee of the Rochdale Corporation have decided to ask the Finance Committee to provide £12,000 to meet the deficiency on their accounts for the year just closed. Last year the deficiency was £13,000. The returns of the Committee show an increase in the income from ordinary water-rentals, and a decrease in the interest payable on loans. It is especially gratifying to find a decrease of £1000 in the Committee's requirements at the end of the year, which has not been remarkably favourable to them in the way of producing unusual sources of income. The extraordinary drought which prevailed during the twelve months ending on March 25, 1888, caused an increase of about £1600 in the revenue of the Water Department for that year. During the following year there was no drought; and consequently no extra revenue of this kind. The increase in the income from ordinary water-rentals amounts to about £500. On the other side of the accounts there appears a decrease in the expenditure compared with that of last year, of about £1200.

EXTENSION OF THE WESTON-SUPER-MARE WATER-WORKS.—Many years ago the necessity for increased means of providing for the growing demand for water at Weston-super-Mare forced itself upon the attention of the inhabitants; and eventually, in 1886, a scheme, prepared by Mr. E. Cousins, M. Inst. C.E., of London, for remodelling the works, and providing additional distributing plant, was approved by the Improvement Commissioners, and obtained the sanction of the Local Government Board. Since then the works necessary for the accomplishment of this scheme have been in progress, and are now practically speaking completed. A well has been sunk 27 feet into the mountain limestone, and connected by means of an adit with the old wells. The diameter of the new well is 15 feet. The pumping plant has been increased by the addition of two of Davey's patent differential compound pumping-engines, fitted with adjustable expansion-valves to both high and low pressure cylinders. The pumps are 15½ inches in diameter; and their stroke is 2 ft. 8 in. There are two pumps to each engine; and they are of the piston type. Steam is supplied from two steel boilers, each 28 feet long by 7 feet diameter. A steam-pump has been provided for draining the main pump bed; also one for feeding the boilers. The engines pump into a new 14-inch rising main, which conveys the water to the low-service reservoir. A new 5-inch rising main has also been laid to the high-service reservoir. With regard to the distributing plant, no less than eleven miles of new mains have been laid, which range in diameter from 15 to 3 inches. About 120 fire hydrants have been placed in position.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For STOCK MARKET INTELLIGENCE, see *ante*, p. 800.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d
590,000	10	11 Apr.	10½	Alliance & Dublin 10 p. c.	10	18½—19½	..	5 7 8
100,000	10	,,	7½	Do. 7 p. c.	10	13—14	..	5 7 2
300,000	100	2 Jan.	5	Australian (Sydney) 5% Deb.	100	110—112	..	4 9 8
100,000	20	29 Nov.	10	Bahia, Limited	20	24—26	..	7 13 10
200,000	5	14 Nov.	7½	Bombay, Limited	5	6¾—7¼	..	5 3 5
40,000	5	,,	7½	Do. New	4	5¾—6¼	..	5 4 2
880,000	Stck.	14 Feb.	11½	Brentford Consolidated	100	229—234	..	5 0 5
125,000		,,	8½	Do. New	100	167—172	..	5 1 9
220,000	20	14 Mar.	10½	Brighton & Hove, Original	20	42—44	..	4 15 5
820,000	20	28 Mar.	11½	British	20	45—47	..	4 15 9
50,000	10	14 Mar.	11	Bromley, Ordinary 10 p. c.	10	20—22	..	5 0 0
39,000	10	,,	8	Do. 7 p. c.	10	13½—14½	..	5 10 4
328,750	10	14 Nov.	8	Buenos Ayres (New) Limited	10	14½—15½	+½	5 3 2
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	100	107—110	..	5 9 1
150,000	20	28 Feb.	8	Cagliari, Limited	20	25—27	..	5 18 6
550,000	Stck.	11 Apr.	13½	Commercial, Old Stock	100	270—275	+1	5 0 0
130,000	,,	,,	10½	Do. New do.	100	214—219	..	4 18 2
130,000	,,	28 Dec.	4½	Do. 4½ p. c. Deb. do.	100	123—128	..	3 10 3
557,320	20	13 Dec.	13	Continental Union, Limited	20	47—49	..	5 6 2
242,680	20	,,	13	Do. New '69 & '72	14	32½—33½	..	5 8 5
200,000	20	,,	10	Do. 7 p. c. Pref.	20	38—40	..	5 0 0
75,000	Stck.	28 Mar.	10	Crystal Palace District	100	204—208	..	4 16 2
234,060	10	30 Jan.	13	European, Limited	10	25½—26½	..	4 18 1
120,000	10	,,	13	Do. New.	7½	17½—18½	..	5 5 3
354,060	10	,,	13	Do. do.	5	12½—13½	..	4 16 3
5,468,600	Stck.	14 Feb.	13	Gaslight & Coke, A, Ordinary	100	260—265	−1	4 18 1
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	100—105	..	3 16 3
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	260—265	..	3 15 6
80,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	123—128	..	3 18 1
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	182—187	+2	4 0 2
1,800,000	,,	,,	7	Do. H, 7 p. c. max.	100	170—175	..	4 0 0
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	258—263	..	3 16 1
1,051,150	,,	13 Dec.	4	Do. 4 p. c. Deb. Stk.	100	120—123	..	3 5 0
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	125—130	..	3 9 3
650,000	,,	,,	6	Do. 6 p. c. do.	100	174—179	..	3 7 0
3,600,000	Stck.	14 Nov.	10	Imperial Continental	100	215—219	+1	4 11 4
75,000	5	13 Dec.	6	Malta & Mediterranean, Ltd	5	5—5½	..	5 9 1
560,000	100	1 Apr.	5	Met. of Melbourne, 5 p.c. Deb.	100	113—115	..	4 6 11
541,920	20	29 Nov.	6	Monte Video, Limited	20	18½—19½	..	6 3 1
150,000	5	29 Nov.	10	Oriental, Limited	5	9¼—9¾	..	5 2 7
60,000	5	28 Mar.	7	Ottoman, Limited	5	6¼—6¾	..	5 3 8
166,870	10	16 Jan.	4	Pará, Limited	10	5½—6	..	6 13 4
420,000	100	2 Nov.	6	People's Gas of Chicago— 1st Mtg. Bds.	100	104—107	..	5 12 1
500,000	100	1 Dec.	6	2nd Do.	100	95—100	..	6 0 0
100,000	10	26 Apr.	10	San Paulo, Limited	10	16—17*	..	5 17 8
500,000	Stck.	28 Feb.	16½	South Metropolitan, A Stock	100	317—322	+2	5 0 11
1,350,000	,,	,,	12½	Do. B do.	100	245—250	+2	4 17 0
141,500	,,	,,	13½	Do. C do.	100	260—270	+5	4 18 1
600,000	,,	28 Dec.	5	Do. 5 p. c. Deb. Stk.	100	137—140	..	3 11 5
60,000	5	28 Feb.	11½	Tottenham & Edm'ntn, Orig.	5	11—13	..	4 8
						*Ex div		
				WATER COMPANIES.				
717,467	Stck.	28 Dec.	9	Chelsea, Ordinary	100	257—262	..	3 8 8
1,720,560	Stck.	11 Apr.	7½	East London, Ordinary	100	204—208	−1	3 12 1
700,000	50	13 Dec.	9	Grand Junction	50	122—126	..	3 11 5
708,000	Stck.	14 Feb.	10½	Kent	100	272—277	..	3 15 9
1,043,800	100	28 Dec.	9	Lambeth, 10 p. c. max.	100	251—256	..	3 16 3
406,200	100	,,	7½	Do. 7½ p. c. max.	100	199—204	..	3 13 6
200,000	Stck.	28 Mar.	4	Do. 4 p. c. Deb. Stk.	100	118—120	..	3 6 8
500,000	100	14 Feb.	12½	New River, New Shares	100	350—355	..	3 8 4
1,000,000	Stck.	30 Jan.	4	Do. 4 p. c. Deb. Stk.	100	125—128	..	3 2 6
902,300	Stck.	13 Dec.	6	S'thwk & V'xhall, 10 p.c. max.	100	174—179	+1	3 7 0
126,500	100	,,	6	Do. 7½ p. c. do.	100	161—166	..	3 12 3
1,155,066	Stck.	,,	10	West Middlesex	100	264—269	..	3 11 4

GWYNNE & CO., ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON, W.C.

GWYNNE & BEALE'S PATENT GAS EXHAUSTERS & ENGINES.

Telegrams: "GWYNNEGRAM, LONDON." Telephone No. 2698.

Exhausters of nearly all sizes in Stock.

Prize Medals at all the Great International Exhibitions.

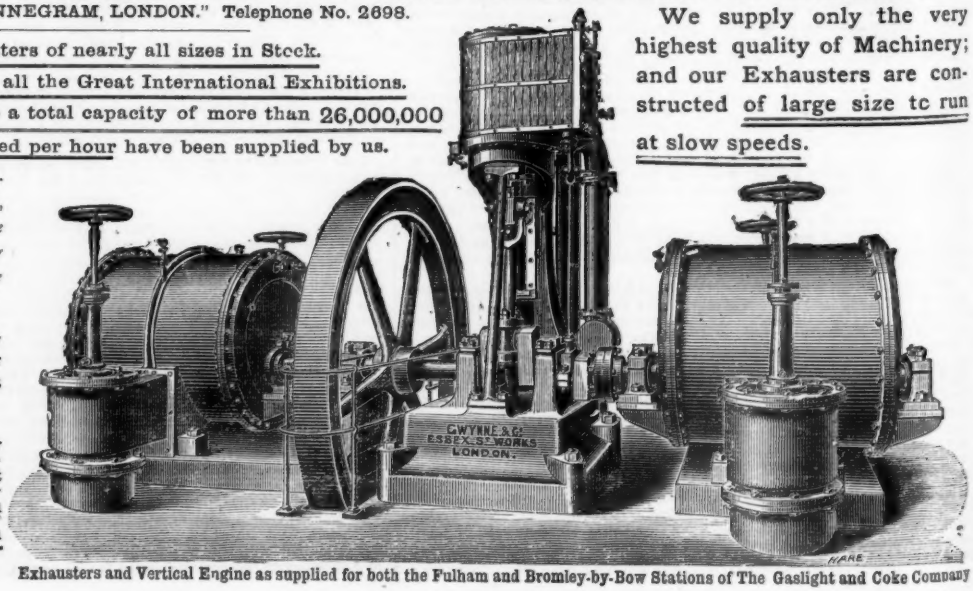
Exhausters equal to a total capacity of more than 26,000,000 cubic feet passed per hour have been supplied by us.

Our new Patent Non-Fluctuating Exhausters, to work without the slightest oscillation or variation in pressure, are strongly recommended.

MAKERS OF EVERY DESCRIPTION OF HYDRAULIC AND GAS MACHINERY.

Gwynne & Co.'s New Catalogue and List of Testimonials can now be obtained on application.

We supply only the very highest quality of Machinery; and our Exhausters are constructed of large size tc run at slow speeds.



Exhausters and Vertical Engine as supplied for both the Fulham and Bromley-by-Bow Stations of The Gaslight and Coke Company

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.
Gas Purification and Chemical Company, Limited, Palmerston Buildings, Old Broad Street, London, E.C.
JOHN WM. O'NEILL, Managing Director.

ANDREW STEPHENSON, Agent for the GAS PURIFICATION AND CHEMICAL COMPANY, Limited, Palmerston Buildings, Old Broad Street, LONDON, E.C.

CANNEL COAL, &c.

JOHN ROMANS & SON, EDINBURGH. Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS AND WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, / No. 54, BERNARD STREET, LEITH, } SCOTLAND.

SULPHURIC ACID, B.O.V., for Sulphate of Ammonia Making. Guaranteed clear, of full strength, and to produce a fine white-coloured salt, Delivered in carboys or railway tank waggons.
For prices and terms address BALE, BAKER, AND CO., 120 & 121, Newgate Street LONDON.

SHIPPING AND INSURANCE.

ROBERT BRUCE FITZMAURICE, 9, Crosby Square, London, E.C., Shipping Agent to several Foreign Gas Companies, is prepared to attend to the Forwarding and Insurance of Goods for Foreign and Colonial Gas Companies, &c., and Gas Plant Manufacturers.
For Rates of Freight, apply as above.

MISS AGNES KELMAN, the well- known and successful Lecturer on Cookery, will be glad to CONDUCT COOKERY CLASSES for Gas Companies, or GIVE LECTURES at Gas Exhibitions.
Address Miss A. KELMAN, 15, Wood Lane, SHEPHERD'S BUSH, W.

CHEMIST, or Appointment under Management, required by Gentleman, F.C.S., with practical experience, as ASSISTANT MANAGER. Intimate knowledge of Accounts; thorough Gas Chemist.
Address No. 1702, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TIMMIS & CO., of STOURBRIDGE Make only the best quality of FIRE-CLAY RETORTS, BRICKS, TILES, & LUMPS. Also SPECIAL SILICA BRICKS, to stand great heats. All descriptions kept in Stock.
For Prices apply to JAMES LAWRIE AND Co, 1, Whittington Avenue, Leadenhall Street, E.C., Sole Agents for London and District.
Telegraphic Address: "EIRWAL, LONDON."

ALEX. WRIGHT & Co., 55, 55a, and 56, MILLBANK STREET, LONDON, S.W.
[Telegraphic Address: "PRECISION LONDON."]
Makers of Wet and Dry Gas-Meters, Station Meters and Governors, Photometers, and Gas-Testing Apparatus, Test Gasholders and Meters, Registering and other Gauges, &c., &c.
*** See Advertisement on Page III. of the Wrapper of last week's issue.

W. C. HOLMES & Co., Huddersfield, AND 80, CANNON STREET, LONDON,
Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also for Collingwood's Regenerative Retort-Settings.
*** See Advertisement p. 835 of this week's issue.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for Wet and Dry Gas-Meters, Station Meters, and Governors, Pressure-Gauges, Street Lamps, and Pillars, &c.
Telegraphic Address: "Braddock, Oldham."

FORCED DRAUGHT.

MELDRUM BROS., Engineers, of 26, Half Street, Cathedral Yard, Manchester, are prepared to Supply and Fix to any ordinary Boiler Furnace complete APPARATUS for burning Breeze, Coal Dust, or other small or poor Fuel. Results guaranteed. Terms on application.

WANTED, a re-engagement as Fitter in Gas-Works. Well up in the Fixing of Cooking and Heating Stoves, and in Lighting Work. Meter Fixing and Reading, Main and Service Laying, and House Fitting. Good references.
Address FITTER, 169, Elderfield Road, Clapton Park, LONDON, N.E.

JUNIOR Draughtsman wanted, one used to Gas Plant preferred. Salary £2 per week.
Apply to No. 1703, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

IRISH BOG ORE OXIDE OF IRON.

GAS PURIFICATION.

BALE, BAKER, & CO., direct Importers from Ireland. Sample and Price on application. Spent Oxide and Sulphate of Ammonia purchased.
120 and 121, NEWGATE STREET, LONDON, E.C.

TUBES.

FOR Gas, Steam, and Water; Galvanized, White Enamelled, and Hydraulic Tubes and Co.
JOHN SPENCER, Globe Tube Works, WEDNESBURY, and 14, Great St. Thomas Apostle, LONDON.

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID for making SULPHATE OF AMMONIA of high quality and colour.
Highest References and all particulars supplied on application.

JOHN RILEY & SONS, Chemical Manu- facturers, Hapton, near Accrington, are MAKERS of SULPHURIC ACID, from Brimstone, for Sulphate of Ammonia making. Highest percentage of Sulphate of Ammonia obtained from the use of this Vitriol. References given to Gas Companies.

HUTCHINSON BROTHERS, Barnsley, Gas Engineers and Contractors, Makers of Gas-Meters and General Gas Apparatus, Sulphate of Ammonia Plant, Tools, and Sundries.
*** See large Advertisement in last week's issue, page 748.

SULPHATE of Ammonia Lead Work and Fittings. Lead Burner. Tanks and Saturators made and repaired on the shortest notice.
Address P. J. DAVIES, 78, Earl's Court Road, Kensington, LONDON.

DRAUGHTSMAN wanted, for a Gas Engineering Works. Must be expeditious, used to modern construction, and able to prepare working drawings.
Apply, by letter, stating experience, age, and salary required, to No. 1704, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by a Coal Factor, Travellers for Southern and Eastern Counties. Must have connection with Gas Companies. State if know any other ground in addition.
Apply, by letter only, to No. 1694, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

C. & W. WALKER.

GASHOLDERS; PURIFIERS;

PURIFYING MACHINES;

CO_2 AND TAR-EXTRACTING WASHERS; SCRUBBERS;

SULPHATE & SULPHUR PLANT;

RETORT MOUTHPIECES; CONDENSERS;

LIFTING APPARATUS; CENTRE AND FOUR-WAY VALVES;

SLIDE VALVES; TAR BURNERS; &C., &C.,

WOOD SIEVES.

ADDRESSES:

8, Finsbury Circus, London, E.C.; Midland Works, Donnington, Salop.

"FORTRESS LONDON," "FORTRESS DONNINGTON,"—Telegraphic.

WANTED, by the Nuneaton Gas Company, a good FITTER, competent to Lay Mains and Services, Fix and Repair Meters, Erect Retort-House Fittings, and do rough Smithing. One who has a knowledge of Gas-Engine and Exhauster, and is also capable of setting Retorts, preferred. To a steady Man, willing to fill up his time on the Works, the situation would be a permanent one.

Apply, with references, stating age and wages required, to

JOHN H. BLAND, Secretary.

Nuneaton, April 27, 1889.

WORKSOP GAS COMPANY.

WANTED, a useful Man to assist and relieve the present Manager. Age from 30 to 35. Must have a good knowledge of Carbonizing; do all Fittings on the Works (including machinery, but not necessarily to be a Gas-fitter); Main and Service Laying; Reading Consumers' Meters, and making out Accounts and taking money in case of change of Tenants, and attend to inquiries of such.

Applications, in own handwriting, stating age, qualifications, present employment, salary required, married or not, with two references (not testimonials), one from present employer, to be sent not later than the 24th day of May, addressed to Mr. BATES, WORKSOP.

REDHILL GAS COMPANY.

WANTED, Two Second-hand Purifiers, 8 or 10 feet square.

Full particulars to the undersigned.

C. READ, Manager.

WANTED, a few Tank-Waggons—new or good second-hand—to hold from 2000 to 2300 gallons each.

Address, stating price, &c., No. 1701, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, Second-hand Gasholder TANK-PLATES.

Apply, stating sizes and thicknesses of plates, price, and where to be seen, to JAMES ROSS AND CO., Lime Wharf Chemical Works, FALKIRK.

WANTED—Any Gas Company having for Sale one LIVESEY WASHER, and one KIRKHAM'S SCRUBBER for 500,000 feet per day, will please communicate with Mr. LONGWORTH, Gas Offices, GUILDFORD.

FOR SALE, to close a Partnership Account—About 20 new BOWER LAMPS, assorted, of 10 and 15 feet. Liberal discount to clear.

Apply COLE, 146, Miller Street, Aston Road, BIRMINGHAM.

FOR SALE—Two good stout Wrought- Iron OIL-TANKS, 7000 and 10,000 gallons each, and three Cast-Iron 4-inch SOCKET ROSIN STILL WORMS, with Wrought Iron Standards and Clips complete. To be immediately cleared for alterations of premises.

Apply to F. MORRIS, Tar and Rosin Distiller, Plough Bridge, Rotherhithe, LONDON, S.E.

THE Tenterden Gas Company are pre- pared to receive TENDERS for 400 tons of best GAS COAL, to be conveyed to Appledore Station.

Tenders to be sent to Mr. Cooper on or before the 7th day of May, 1889.

DENTON AND HAUGHTON LOCAL BOARD.
(GAS DEPARTMENT.)

TAR.

THE Gas Committee require Offers, on or before May 11, 1889, for TAR.

Particulars may be obtained from Mr. J. M. Veevers, Gas-Works, Denton, near Manchester.

By order,
JOHN RICHARDS, Clerk to the Board.

DENTON AND HAUGHTON LOCAL BOARD.
(GAS DEPARTMENT.)

CANNEL AND COAL.

THE Gas Committee require Tenders, on or before May 1st, 1889, for CANNEL and COAL.

Specifications and form of tender may be obtained from Mr. J. M. Veevers, Gas-Works, Denton, near Manchester.

By order,
JOHN RICHARDS,
Clerk to the Board.

THE Colwyn Bay and District Gas and Lighting Company, Limited, invite TENDERS for the enlargement of their Works at Colwyn Bay, consisting of a GASHOLDER, to hold about 30,000 cubic feet, additional PURIFIERS, &c.

Plans and specifications can be seen at the Company's Office, in the Public Hall, Colwyn Bay, from Monday, April 29, to Saturday, May 4 (inclusive), between the hours of Eleven and One.

Tenders to be in the Secretary's hands not later than Ten a.m. on Wednesday, May 8, 1889.

The Company do not bind themselves to accept the lowest or any tender.

T. J. LINEKAR, Secretary.

April 17, 1889.

TO ENGINEERS, ETC.

THE Corporation of Birkenhead are prepared to receive TENDERS for the Supply and Erection of STAGE FLOOR, HYDRAULIC MAINS, RETORT-BENCH FITTINGS, &c., at their No. 3 Retort-House, Gas-Works, Thomas Street, Birkenhead.

Plans and Specifications may be seen and Quantities obtained (upon deposit of one guinea), from the Engineer, Mr. T. O. Paterson, at the Works.

Tenders, sealed and endorsed "Retort-House Iron-work," must be sent in to me not later than Five p.m. on Friday, the 17th of May, 1889.

The Corporation do not bind themselves to accept the lowest or any tender.

By order,
ALFRED GILL, Town Clerk.

Town Hall, Birkenhead, April 24, 1889.

TO TAR DISTILLERS AND MANUFACTURING CHEMISTS.

THE Directors of the Wellington (Salop) Coal and Gaslight Company invite TENDERS for the purchase of the surplus TAR to be produced at their Works for One year, from the 1st of June next.

Particulars may be obtained from the undersigned, to whom tenders should be sent on or before May 10.

JNO. C. BELTON, Manager.

Wellington, Salop, April 12, 1889.

RETORTS, FIRE-BRICKS, ETC.

THE Directors of the Wakefield Gaslight Company are prepared to receive TENDERS for the supply and delivery at the Gas-Works, Wakefield, of 1700 feet run of RETORTS, D-shaped, 19 in. by 14 in. and 20 in. by 14 in. in lengths of about 10 feet; and the necessary FIRE-BRICKS, &c., required in the setting of the same.

Tenders, endorsed, to be sent in not later than Saturday next, the 4th of May.

By order,
JOHN W. WHITAKER,
Secretary and Manager.

Gas Office, Wakefield, April 26, 1889.

SUTTON-IN-ASHFIELD LOCAL BOARD.
(GAS DEPARTMENT.)

TO TAR DISTILLERS AND OTHERS.

THE Gas Committee of the Sutton-in- Ashfield Local Board are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR produced at their Works during the ensuing year.

Particulars may be obtained on application to the Manager, at the Gas-Works, Sutton-in-Ashfield, Notts.

Tenders, stating price per ton of 20 cwt. at the Works, to be addressed to "The Clerk to the Local Board, Local Board Offices, Sutton-in-Ashfield," and marked "Tender for Tar and Liquor," so as to arrive not later than Tuesday, the 30th of April, 1889.

By order,
G. H. HIBBERT,
Clerk to the Committee.

Local Board Office, Sutton-in-Ashfield, Notts.

SUTTON-IN-ASHFIELD LOCAL BOARD.
(GAS DEPARTMENT.)

SUPPLY OF GAS COAL.

THE Gas Committee of the above Local Board are prepared to receive TENDERS for the supply of 2200 tons of well-screened GAS COAL and 250 tons of CANNEL, to be free from Shale and Pyrites, and to be delivered at the Railway Station, Sutton, in such quantities as the Manager shall from time to time direct, between July 1, 1889, and June 30, 1890.

Particulars may be obtained on application to the Manager, at the Gas-Works, Sutton-in-Ashfield, Notts.

Tenders, stating price, to be addressed as above, and marked "Tender for Coal," so as to arrive not later than Tuesday, the 30th of April, 1889.

By order,
G. H. HIBBERT,
Clerk to the Committee.

Local Board Offices, Sutton-in-Ashfield, Notts.

The Subscription List will be opened on Thursday, the 2nd of May, and will be closed on or before Tuesday, the 7th of May next.

THE GAS, WATER, & GENERAL INVESTMENT TRUST,

LIMITED.

CAPITAL £1,500,000, in 150,000 SHARES of £10 each.

Subscribed Capital, £500,000.

Issue of £250,000 Four per Cent. Perpetual Registered Debenture Stock.

PRICE OF ISSUE, 101 PER CENT.

Payments to be made as follows:—10 per cent. on application; 21 per cent., which includes the Premium (on such amount as may be allotted), on allotment; £35 on or before the 7th of June next; and the remaining £35 on the 8th of July next.

Subscribers can pay up in full on and after Allotment. Prepayments may be made under Discount at the rate of 3 per cent. per annum.

Directors.

THOMAS SALT, ESQ., M.P., *Chairman.*
The HON. EVELYN ASHLEY.
CHARLES BARCLAY, ESQ.
JOHN BOUSTEAD, ESQ.
JOSEPH BEVAN BRAITHWAITE, ESQ.
LORD CLAUD HAMILTON.
The HON. HENRY NOEL.

Bankers.

THE NATIONAL PROVINCIAL BANK OF ENGLAND, LIMITED (112, Bishopsgate Street, E.C.), and BRANCHES.
LLOYD'S, BARNETT'S and BOSANQUET'S BANK, LIMITED (72, Lombard Street, E.C.), and BRANCHES.

Brokers.

MESSRS. FOSTER & BRAITHWAITE, 27, Austin Friars, E.C. | MESSRS. COLEMAN & MAY, 2, Tokenhouse Buildings, E.C.

Solicitors. | **Auditors.**

MESSRS. PAINE, SON, & POLLOCK, 14, St. Helen's Place, E.C. | MESSRS. DELOITTE, DEVER, GRIFFITHS, & CO., Lothbury, E.C.

Secretary. | **Offices.**

JAMES A. KELMAN, ESQ. | WINCHESTER HOUSE, E.C.

The Directors have, in accordance with the powers conferred on them by the Articles of Association, authorized an issue of £500,000 Four per Cent. Perpetual Debenture Stock, of which £250,000 is now offered at 101.

The Stock will be registered in the Books of the Company, and Interest at the rate of Four per Cent. per annum will be sent half-yearly to the registered holder on the 1st of January and the 1st of July in each year. During the first half year interest will accrue from the dates of the several instalments.

By the Articles of Association, the Debenture issue of the Trust can in no case exceed the amount of Share Capital subscribed.

This Debenture Stock provides a security of the highest class, and the rate of interest compares favourably with the under-mentioned securities.

2½ per Cent. Consols	returning about	2¾
First-class English Railway Debenture Stocks	„	to 3⅛
First-class English Railway Preference Stocks	returning about	3½
Corporation Bonds (United Kingdom) . .	„	3 to 3½
The Best Colonial Inscribed Stock . . .	„	3½ to 3⅝

A quotation for this Stock in the Official List will be applied for in due course.

Copies of the Resolution of the Board creating and containing the conditions of the Debenture Stock can be seen or obtained at the Offices of the Company.

Application should be made on the form accompanying the Prospectus.

Prospectuses and forms of application can be obtained at the Bankers, Brokers, or Offices of the Company.

Dated May 1, 1889.

BUXTON LOCAL BOARD.

THE Gas Committee invite Tenders for the supply of good CANNEL for One or more years, at the rate of about 2800 tons per Annum, to be delivered at their Siding (on the Midland Railway) in Ashwood Dale, Buxton.

Tenders, endorsed "Tender for Cannel," addressed to the Chairman of the Gas Committee, to be delivered at the Local Board Offices, in George Street, not later than Noon on the 7th of May.

Forms of tender and other particulars may be obtained of Mr. G. Smedley, Engineer, Gas Office, Bridge Street, Buxton.

The Board do not bind themselves to accept the lowest or any tender.

By order,
JOSIAH TAYLOR, Clerk.

CORPORATION OF LEICESTER.

COAL TENDERS.

THE Gas Committee of the above Cor- poration are prepared to receive TENDERS for the supply of COALS, COBBLES, or NUTS (about 95,000 tons per annum), for One, Two, or Three years, ending May 31.

Particulars and form of tender can be obtained on application to the Engineer.

Tenders, addressed to Councillor Lennard, Chairman, and endorsed "Tender for Gas Coal," to be delivered at these Offices not later than Eleven o'clock a.m. on Saturday, May 11 prox.

The Committee do not bind themselves to accept the lowest or any tender.

ALFRED COLSON, C.E.,
Engineer and Manager.

Gas Offices, Millstone Lane, Leicester,
April 11, 1889.

ROCHESTER, CHATHAM, AND STROOD GAS-LIGHT COMPANY.

SUPPLY OF COALS.

THE Directors of the above Company invite TENDERS for the supply of 84,800 tons of GAS COALS, to be delivered in the Year commencing the 1st of July next, and ending the 30th of June, 1890.

Particulars and copy of form of contract may be had on application to

WILLIAM SYMS,
Secretary and Manager.

Gas Office, 58, High Street, Rochester,
April 27, 1889.

TO TAR DISTILLERS, MANUFACTURING CHEMISTS, AND OTHERS.

THE Directors of the Rochester, Chat- ham, and Strood Gaslight Company are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR produced at their Works at Rochester and at Gillingham for One, Two, or Three years, commencing the 1st of July next. In 1888 the quantity of Tar was about 290,000 gallons; of Liquor, about 910,000 gallons.

Further particulars may be had on application at the Office of the Company, 58, High Street, Rochester.

Tenders may be for Tar or Liquor separately or together, and are to be delivered at the Office, marked "Tender for Tar" or "Liquor," not later than Noon of Thursday, the 23rd of May.

The Directors do not bind themselves to accept the highest or any tender; and security for due fulfilment of the contract must be given if required.

WILLIAM SYMS,
Secretary and Manager.

Gas Office, 58, High Street, Rochester,
April 27, 1889.

MANCHESTER CORPORATION GAS-WORKS.

SPENT OXIDE.

THE Gas Committee of the Corporation of Manchester are prepared to receive TENDERS for the PURCHASE and REMOVAL of the SPENT OXIDE to be produced at their Gaythorn, Rochdale Road, and Bradford Road Works, during a period of One, Two, or Three years from the 30th of June next.

The Committee do not bind themselves to accept the highest or any tender.

Sealed tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Spent Oxide," must be delivered at the Offices of the Gas Department, Town Hall, on or before Thursday, the 23rd day of May next.

Forms of tender and further particulars may be obtained on application, in writing, to Mr. Charles Nickson, Superintendent of the Gas Department.

By order of the Gas Committee,
JOSEPH HERON, Town Clerk.

Town Hall, Manchester, April 26, 1889.

MANCHESTER CORPORATION GAS-WORKS.

TAR AND AMMONIACAL LIQUOR.

THE Gas Committee of the Manchester Corporation are prepared to receive TENDERS for the PURCHASE and REMOVAL of the TAR and AMMONIACAL LIQUOR to be produced at their Droylsden Station during a period of One or more years from the 24th of June next.

The Committee do not bind themselves to accept the highest or any tender.

Sealed tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Tar and Liquor, Droylsden," must be delivered at the Offices of the Gas Department, Town Hall, on or before Thursday, the 23rd day of May next.

Forms of tender and further particulars may be obtained on application, in writing, to Mr. Charles Nickson, Superintendent of the Gas Department.

By order of the Gas Committee,
JOSEPH HERON, Town Clerk.

Town Hall, Manchester, April 26, 1889.

TENDERS FOR COAL.

THE Scarborough Gas Company invite TENDERS for the supply of about 8000 tons of best screened SILKSTONE GAS COAL or COBBLES per Annum, for One or Two years, from the 1st day of July next.

Tenders, endorsed "Tender for Coal," must be delivered at the Company's Offices not later than Ten o'clock a.m. on Monday, the 13th day of May next.

The Directors do not bind themselves to accept the lowest or any tender.

By order,
WILLIAM J. MOON,
Secretary and Manager.

Scarborough, April 24, 1889.

TO TANK CONTRACTORS.

THE Paisley Gas Corporation invite TENDERS for the Construction of a BRICK GASHOLDER TANK, 162 feet diameter and 36 ft. 6 in. deep.

Drawings and specifications may be seen, and all necessary particulars obtained, on application to the undersigned.

Tenders, sealed and endorsed "Tender for Gasholder Tank," to be lodged with Messrs. Young and Martin, Town Clerks, Paisley, on or before the 16th day of May prox.

The Committee will not be bound to accept the lowest or any tender.

GEO. R. HISLOP, Engineer.

Paisley Gas-Works, April 23, 1889.

THE BRISTOL UNITED GASLIGHT COMPANY.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Bristol United Gaslight Company are prepared to receive TENDERS for the Supply of their requirements (say, 150,000 tons) of GAS COALS during a period of One year, commencing the 1st of July next.

Particulars and forms of tender may be obtained on application to the undersigned, to whom also tenders, sealed, and endorsed "Tender for Coal," must be delivered not later than Ten a.m., on Monday, the 3rd day of June next.

JAS. V. GREEN, Secretary.

Gaslight Offices, Canon's Marsh,
Bristol, April 26, 1889.

TENDERS FOR COALS.

THE Directors of the Town of Dudley Gaslight Company are prepared to receive TENDERS for the supply of 10,000 tons of GAS COALS, to be delivered at the London and North-Western Railway or Great Western Railway Sidings, Dudley, in such quantities as may be required from the 1st of July, 1889, to the 30th of June, 1890.

Sealed tenders, addressed to the Chairman, and endorsed "Tender for Coals," to be sent in not later than the 14th of May next.

The Directors do not bind themselves to accept the lowest or any tender, and reserve to themselves the right to divide the contract between two or more firms.

By order,
T. E. STILLARD, Secretary.

Gas-Works, Dudley, April 17, 1889.

BOROUGH OF HALIFAX.

THE Gas-Works Committee of the Halifax Corporation are prepared to receive TENDERS (from Colliery Proprietors only) for the supply of 45,000 tons of GAS COAL, and 10,000 tons of CANNEL, to be supplied in such quantities as may from time to time be determined by the Gas-Works Committee during the year ending the 30th of June, 1890.

Forms of tender and further information may be obtained on application to Mr. Thomas Holgate, Manager, Gas-Works, Halifax.

Tenders, endorsed "Tender for Coal," must be sent to me on or before the 9th of May, 1889.

By order,
KEIGHLEY WALTON, Town Clerk.

Town Hall, Halifax, April 20, 1889.

CORPORATION OF NOTTINGHAM.
(GAS DEPARTMENT.)

TENDERS FOR COALS.

THE Gas Committee are desirous to re- ceive OFFERS for supplies of COALS, COBBLES, or NUTS for the period terminating the 30th of June, 1890.

The large Coals and the Cobbles or Nuts are to be separately delivered, where and as from time to time directed, by and at the expense of the Contractors, upon the Gas-Works Siding, Great Northern Railway, in the East Croft, at Nottingham, and also on the Gas-Works Sidings, Midland Railway, at Radford and Basford respectively; and at and after the rate of one-eighth part of such total quantity in each calendar month, commencing with the month of July next, till the Corporation shall be satisfied with the amount of accumulated stock, and afterwards at such rate as shall be from time to time directed, till the agreed quantity shall have been delivered.

The Coals, Cobbles, or Nuts are to be the best of their respective kinds, well screened (description, sizes, and inclination of screen to be specified), to be as free as possible from sulphur, bats, bind, refuse, and dirt, and shall be weighed (20 cwt. to the ton) upon the Corporation machines, or upon such other machines as may be mutually agreed upon.

Payments will be made monthly, if and so long as the contract shall be duly fulfilled.

The Corporation do not bind themselves to accept the lowest or any tender.

Further information and forms on which the tenders must be made may be obtained on application to me, at the General Manager's Office; and the tenders (sealed) specifying the description of Coals and the pits at which they are to be raised, and stating the prices for deliveries at the several places and in manner and subject to the conditions aforesaid, must be delivered to Samuel George Johnson, Esq., Town Clerk, on or before Tuesday, the 7th day of May, 1889.

By order,
WILLIAM R. CHESTER,
Engineer and General Manager.

Corporation Gas Offices, George Street,
Nottingham, April 17, 1889.

COKE AND TAR.

THE Directors of the Nuneaton Gas Com- pany invite TENDERS for the surplus COKE and TAR to be produced at their Works for One year from the 1st day of July next.

Quantity of Coke, about 800 tons; quantity of Tar about 150 tons.

Tenders, sealed and endorsed, must reach me not later than Wednesday, the 8th of May.

JOHN H. BLAND, Secretary.

Nuneaton, April 27, 1889.

GEORGETOWN (BRITISH GUIANA) GAS COMPANY, LIMITED.

NOTICE is hereby given that the ORDINARY GENERAL MEETING of the Shareholders of the above Company will be held at the Offices of the Company, 30, Gracechurch Street, in the City of London, on Tuesday, the 21st day of May next, at Three o'clock in the Afternoon precisely, to receive the Directors' Report and the Accounts of the Company for the Half Year ended the 31st day of December last, to declare a Dividend, to elect Directors and an Auditor in the place of those retiring by rotation, and to transact the General Business of the Company.

The Transfer Books will be closed from the 7th to the 21st prox., both inclusive.

By order of the Board,
ALFRED LASS, Secretary.

Offices: 30, Gracechurch Street,
London, April 23, 1889.

TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their Invention may be secured for Twelve months; or LETTERS PATENT, which are granted for Fourteen Years.

Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.

Patents procured for Foreign Countries.

Information as to cost, &c., supplied gratuitously upon application to the Advertiser, 23, Great George Street, WESTMINSTER.

ROBERT MARSHALL,

CANNEL COAL MERCHANT,

97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on application.

JAMES OAKES & CO.,

ALFRETON IRON-WORKS, DERBYSHIRE,

AND

WENLOCK IRON WHARF, 21 & 22, WHARF ROAD CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1¼ to 48 Inches in diameter; and make and erect to order RETORTS, PURIFIERS, and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts, and covers, and rendering leakage impossible.

THE

LANEMARK COAL Co., LTD.,

Now offer their superior

GAS COALS

LANEMARK CANNEL.

Yield of Gas per ton . . 10,880 cub. ft.
Illuminating Power . . 29·21 candles.
Coke per ton . . . . 1266·96 lbs.

LANEMARK GAS COAL.

Yield of Gas per ton . . 11,379 cub. ft.
Illuminating Power . . 17·88 candles.
Coke per ton . . . . 1285·53 lbs.

LANEMARK GAS BRIQUETTES.

Yield of Gas per ton . . 10,734 cub. ft.
Illuminating Power . . 22·70 candles.
Coke per ton . . . . . 1320 lbs.

For Prices and Analyses, apply to

LANEMARK COAL Co., Ltd.,

NEW CUMNOCK, N.B.

TROTTER, HAINES, & CORBETT,
BRETTELLS' ESTATE
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICK,
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAYS.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

COKE BREAKERS,
FROM £14 EACH.
(THOMAS & SOMERVILLE'S PATENT.)

New Design, with two Cutting Rollers, making less Breeze than their old pattern.

GEORGE WALLER & CO.,
PARK STREET, SOUTHWARK, S.E.

CAST-IRON PIPES
FOR GAS AND WATER.
VALVES
FOR GAS, WATER, AND STEAM.

TELEGRAMS: "PIPES GLASGOW."
WM. MACLEOD & CO.,
56, ROBERTSON STREET, GLASGOW.

GAS COAL.

POPE & PEARSON, LTD.,
have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields in practical working over 10,000 cubic feet of gas, with an illuminating power of 16 candles; or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17¼ candles.

One ton yields 12¼ cwt. of good coke.

This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

For further particulars apply to POPE AND PEARSON, LIMITED, West Riding and Silkstone Collieries, near LEEDS.

THE
"SILVER" LIGHT.

CHANDLER'S PATENT.
SUITABLE FOR EVERY FORM OF LIGHTING.

A beautiful white light from ordinary Gas. Silent, steady, and economical.

PACKED IN BOX 9s., SUBJECT.

S. CHANDLER & SONS,
Central Works, Kennington Oval, S.E.

To effect a great saving in
GAS-FURNACES use our
Special Derbyshire **GANNISTER BRICKS.**
ADDRESS
JAMES WHITE & Co.,
ALBERT WORKS, WIDNES.

MARQUIS OF LOTHIAN'S
NEWBATTLE CANNEL.

QUOTATIONS ON APPLICATION TO
MR. JOHN MORISON,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

THOMAS ILLINGWORTH,
NORTH DEAN CHEMICAL WORKS,
Near HALIFAX,
MANUFACTURER OF SULPHURIC ACID
OF EXTRA QUALITY FOR MAKING
WHITE SULPHATE OF AMMONIA.

TAR, LIQUOR, AND SPENT OXIDE
Purchased for Cash against Delivery.

GAS AND WATER PIPES.
1½ to 12 IN. BORE.

THOMAS ALLAN & SONS,
Bon Lea Foundry,
SOUTH STOCKTON-ON-TEES.

ALSO MANUFACTURERS OF
SANITARY & RAIN-WATER PIPES, HOT WATER PIPES, STABLE FITTINGS, RANGES, STOVES, And GENERAL CASTINGS.
GLASGOW OFFICE: 7, WEST GEORGE STREET.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for
CANNEL & COAL.

TYNE BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles,
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cent.

For Prices and complete Analysis, apply to
YOUNG, DANCE, & CO.,
COAL OWNERS, NEWCASTLE-ON-TYNE,
Or E. FOSTER & CO., 21, John St., Adelphi, LONDON, W.C.

THE ONLY RELIABLE
DRY CENTRE-VALVE.
WORKING ONE, TWO, THREE, OR FOUR PURIFIERS ON AT THE TIME.
ALSO MADE FOR TWO OR THREE PURIFIERS.
No Springing. No Leakage. No Foul Gas passed in Changing. Special Facility for Blowing the Air out of the Fresh Box before putting in Action, without driving it forward into the Holders.
Write for Prospectus.
ALSO DOUBLE-ACTION DOUBLE-FACED GAS & WATER VALVES.

F. WECK, 86, NEW STREET, BIRMINGHAM.

UNEQUALLED.
Gas Companies are solicited to try Samples of the
MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
MIRFIELD, NORMANTON.

THOMAS TURTON AND SONS, LIMITED,
SHEAF AND SPRING WORKS
SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES, SPANNER RATCHET BRACES, LIFTING-JACKS, ANVILS, VICES,
ND ENGINEERS' TOOLS GENERALLY,
LONDON OFFICE:
90, CANNON STREET, E.C.

Jos. EVANS & SONS
WOLVERHAMPTON.
PUMPS
FOR
STEAM AND OTHER POWER.

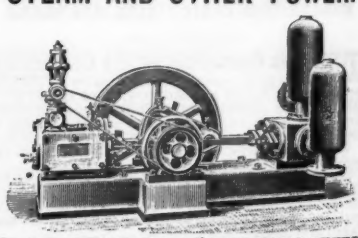


Fig. 685.—EVANS' Patent "RELIABLE" REVERSIBLE TAR and LIQUOR PUMP. In use everywhere. The Best in the World.

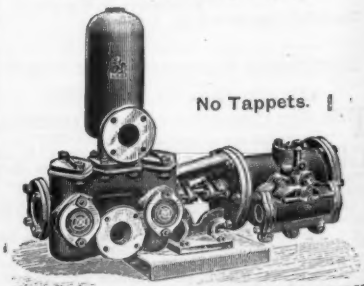


Fig. 600.—EVANS' Patent "CORNISH" DIRECT-ACTING STEAM-PUMP. FOR EVERY PURPOSE.

SEE NEW CATALOGUE.

TO GAS MANAGERS. SULPHATE OF AMMONIA PLANT.

CLIFF JOHN, & SONS, 7, WELLINGTON ST., LEEDS. Telegrams—"Fire-Brick, Leeds." Works: "Cliff, Potteries, Runcorn." FIRE-BRICKS & RETORTS.

N.B. This Firm will quote on application their Discount Price of all Fire-Clay Goods. "Leeds" and "Yorkshire" qualities.

CHEMICAL STONEWARE "The best" for resisting Acids.

TAPS SEND FOR PRICE LIST.

D. HULETT & CO. Invite attention to the following Specialities:—

PATENT STREET LAMPS,

NO PUTTY OR OTHER MATERIALS ARE REQUIRED TO SECURE THE GLASS. PRICE 9s. 9d. EACH NET.

D. Hulett's Improved Service Cleanser, for the removal of Naphthalene and other obstructions in Service-Pipes. Price 70s. net.

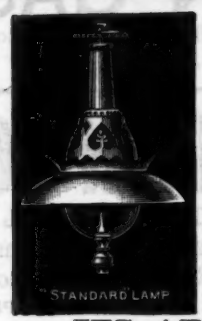
IMPROVED HIGH-POWER LANTERNS; PRICES ON APPLICATION.

Patentees of Improved Wet and Dry Gas-Meters.

Makers of Pressure-Gauges, Gaseliers, and every kind of Gas-Fittings for the Trade.

SHOW-ROOM AND WORKS: **55 & 56, HIGH HOLBORN, LONDON.**

"LIGHT, Wenham Gas Lamps MORE LIGHT."



ITS ADVANTAGES ARE:

IMMENSE ECONOMY IN THE CONSUMPTION OF GAS.

INTENSITY, PURITY, AND STEADINESS OF THE LIGHT.

Absence of Downward Shadow. Practical Completeness of Combustion.

CAN BE FITTED TO ORDINARY SUPPLY-PIPES WITHOUT ALTERATION.

CAN BE USED AS VENTILATING LIGHTS, whereby the products are removed, and damage to decorations, &c., prevented.

SOLE PROPRIETORS AND MANUFACTURERS: **THE WENHAM COMPANY, LIMITED.**

Birmingham Branch: 131, CORPORATION STREET. Works: UPPER OGLE ST., LONDON, W. Manchester Branch: 5, DEANSGATE.

ASHMORE, BENSON, PEASE, & CO., LTD., STOCKTON-ON-TEES.

ENGINEERS & CONTRACTORS
Manufacturers of GAS APPARATUS & PLANT
GAS WORKS Designed & Constructed ABROAD AND HOME
ASHMORE BENSON PEASE & CO
STOCKTON-ON-TEES
MAKERS OF THE LARGEST GAS HOLDER IN THE WORLD
GASHOLDERS, TANKS, SCRUBBERS
CONDENSERS, PURIFIERS, TOOLS
GIRDERS, ROOFS & General CONSTRUCTIONAL IRONWORK
SEE CATALOGUE
STEEL COAL SCOOPS A SPECIALITY
BOILERS
PUMPS
STEEL RETORT LIDS A SPECIALITY

RUSCOE'S PATENT MACHINE

FOR DRILLING AND TAPPING WATER-MAINS AND GAS-MAINS UNDER PRESSURE.

Patent Saddle Back and Drilling Apparatus, whereby Gas and Water Mains can have 2-in., 3-in., 4-in., 5-in., and 6-in. Branches put on without loss of Water or Gas.

Sole Maker of HELPS' PATENT PIPE EXTRACTOR.

Prices and Particulars on Application to

JOHN RUSCOE, Albion Works, Hyde, near Manchester.

GAS COAL.

BEST

REAL OLD SILKSTONE GAS COAL.

Address, THE STRAFFORD COLLIERIES COMPANY,
NEAR BARNSLEY, SOUTH YORKSHIRE.

JOHN BROWN & CO., LIMITED,

ATLAS STEEL AND IRON WORKS, SHEFFIELD,

ALDWARKE MAIN GAS COAL.

This Coal yields 12,600 feet of 19-candle gas per ton.

Weight of illuminating matter in pounds of sperm, 820·80. Very free from impurities.

THE WIGAN COAL & IRON CO., LIMTD.,

Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

MIDLAND DISTRICT OFFICE: 22, TEMPLE STREET, BIRMINGHAM—AGENT: A. C. SCRIVENER.

TELEGRAPHIC ADDRESS: "WIGAN, BIRMINGHAM." TELEPHONE No. 200.

SPECIALITIES.

THE "NUGENT" RECUPERATIVE RETORT SETTINGS and FURNACES.

"ROBUS" IMPROVED RETORT SETTINGS, with COKE, TAR, and BREEZE FURNACES.

THE ABOVE SETTINGS & FURNACES ARE PROVING EMINENTLY SATISFACTORY.

Every Particular, with Estimates, forwarded upon Application to

MESSRS. J. & H. ROBUS,

CONTRACTORS FOR THE ERECTION OF GAS & WATER WORKS,

37, WALBROOK, LONDON, E.C.

JOSEPH CLIFF AND SONS,

THE ORIGINAL (ESTABLISHED 1795).

WORTLEY FIRE-BRICK WORKS,

NEAR LEEDS.

SPECIAL NOTICE.—Our Patent Machine-Made Retorts have now been thoroughly tested, and have proved themselves infinitely superior to those made by hand. At several large works it has been settled, beyond question, that, owing to the compactness and general excellence, more gas is sent to the gasholder from each ton of coal carbonized than is the case with hand-made Retorts.

AT THE PARIS EXHIBITION, 1878,

THREE MEDALS AND HONOURABLE MENTION

WERE AWARDED TO

JOSEPH CLIFF & SONS,

For their Various Exhibits, amongst which is a

SILVER MEDAL FOR THEIR PATENT MACHINE-MADE RETORTS AND FIRE-BRICKS,

Being the Highest Honour given for this Class.

London Wharf: No. 4, Inside Great Northern Goods Station, King's Cross, N. Liverpool: Leeds Street.

SAMUEL CUTLER & SONS,

Contracting Gas Engineers.

BEST MODERN APPARATUS SUITABLE FOR WORKS OF ANY SIZE QUICKLY SUPPLIED FROM S. C. & SONS', OR SPECIAL DESIGNS.

The "Perfect" Condenser.

MORRIS & CUTLER'S PATENT.

OVER

50

IN OPERATION.

EXTENSIVELY ADOPTED

BOTH IN

ENGLAND AND ABROAD.

THIS USEFUL ADJUNCT TO HYDRAULIC MAINS CONTINUES TO GIVE EXCELLENT RESULTS.

ILLUMINATING POWER OF GAS IS INCREASED.

MAIN IS KEPT FREE FROM TAR AND A UNIFORM LIGHT LIQUOR SEAL IS INSURED.

LIVESEY & TANNER'S DIFFERENTIAL TAR & LIQUOR OVERFLOWS.

TESTIMONIALS.

Croydon Commercial Gas and Coke Company,
Messrs. S. Cutler & Sons. *May* 29, 1888.

Gentlemen,—In answer to your letter of the 26th inst., I am pleased to be able to say that I am so satisfied with the LIVESEY AND TANNER TAR OVERFLOWS which I have had in use during the past winter, that I have recommended their adoption throughout our retort-houses.

I am, yours faithfully, J. W. Helps.

Messrs. S. Cutler & Sons. *Gas-Works, Tunbridge Wells, Feb.* 15, 1889.

Gentlemen,—In reply to your inquiry respecting LIVESEY AND TANNER'S TAR AND LIQUOR OVERFLOWS, I have much pleasure in saying that they continue to give every satisfaction.

A few months ago I had a very striking proof of their value. I started four Beds without the "Overflows," allowing the Tar to travel along with the Gas, when the illuminating power dropped a candle, and did not regain the loss until the "Overflows" had been put into operation. This experiment was repeated with the same result.

The apparatus requires but little attention; and if a small quantity of tar is run off regularly every morning, nothing further is required.—Yours faithfully,

Andrew Dougall, Jun., Assoc. M. Inst. C.E.

PROVIDENCE IRON-WORKS,

MILLWALL, LONDON.

BELL'S ASBESTOLINE.

REGISTERED.

All kegs are labelled as above.

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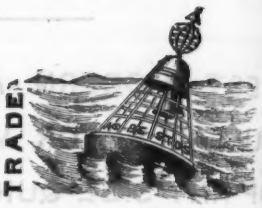
ASBESTOLINE is the most efficient Lubricant for all bearings.
ASBESTOLINE is the cheapest Lubricant.
ASBESTOLINE saves from 50 to 90 per cent. of the Cost of Oil.
ASBESTOLINE is the Cheapest Lubricant.
ASBESTOLINE is favoured by Insurance Companies.
ASBESTOLINE is the most Inodorous Lubricant.
ASBESTOLINE is the safest Lubricant from Ignition.
ASBESTOLINE has beaten all other Lubricants in trials.
ASBESTOLINE is applicable in and out doors in every Climate.
ASBESTOLINE requires no special application.



BELL'S ASBESTOS.

CONSISTENCY OF ASBESTOLINE.

ASBESTOLINE, to meet all circumstances, is made in four degrees of consistency—A, B, C, and CC.

ASBESTOLINE, A, is specially adapted to ordinary Land Engines and Machinery, in and out door, in this country.

ASBESTOLINE, B, a little more solid, is for use on Steamships in temperate climates, also on land when it is desirable to have Lubricant stiffer than A.

ASBESTOLINE, C, is for use in tropical climates, both ashore and afloat. It is also invaluable in works in this country when the temperature is high.

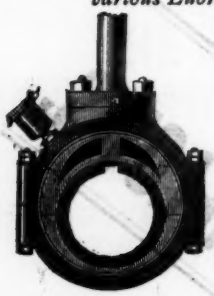
ASBESTOLINE, CC, is designed for use on Calenders, Paper-Machines, &c., where the bearings are heated by steam passing through, and sometimes is advantageously used instead of C.

The reputation of Asbestoline as a Lubricant of the highest efficiency in every kind of Machinery is established; and it has never been equalled by any other Lubricant in the numerous cases of special difficulty in which the best oils are ineffectual. It is used with marked success in Steel and Iron Works, Collieries, Cotton and Wool Mills, and other Textile Manufactories. In Corn-Mills it has proved invaluable on the roller and other modern machines. In Saw-Mills, on machines going up to 6000 revolutions per minute, its work has never been approached by any other Lubricant. On Electric Lighting Machinery, and in Steamships of all sizes throughout the world, the success of Asbestoline is unequalled. Many engines and machines of all descriptions give trouble, and show bad results both in working and wear, when the system of lubrication has not received due consideration. Engineering firms of the highest standing have given to it their powerful testimony and support.

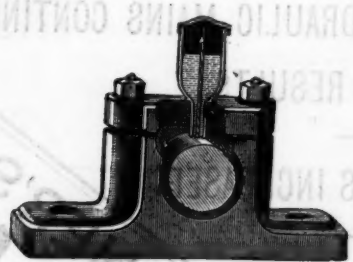
Supplied in Kegs, 28, 56, or 112 lb. Price, 2/3 per lb. Kegs Free. Special Terms for Large Quantities.

IMPORTANT TO EXPORT MERCHANTS.—*One pound of "Asbestoline" equals 2 gallons of Oil weighing 18lbs.; consequently the saving in freight is very considerable. Liberal Terms are conceded to Export Merchants.*

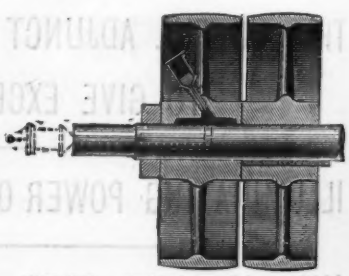
Below will be found illustrations of the mode of fixing Lubricators for Asbestoline to bearings. Full particulars of the various Lubricators supplied for Asbestoline, and the manner of fitting, in catalogue free on application.



Lubricator fitted to Eccentric of Vertical Engine



Showing Section of Lubricator fitted to ordinary Bearings.



Lubricator in different position for Loose Pulleys.

THE ATTENTION OF

ENGINEERS, AND ALL USERS OF STEAM POWER AND MACHINERY,

IS SPECIALLY INVITED TO THE FOLLOWING REPORT.

Owing to the number of Greases now offered, samples of BELL'S ASBESTOLINE were submitted to Otto Hehner, Esq., for analysis, and the subjoined Report fully proves BELL'S ASBESTOLINE to be the safest as well as the best Lubricant for all purposes:—

The Laboratory, 11, *Billiter Square, E.C., London, May* 3, 1888.

I have subjected a sample of Bell's Asbestoline taken from the stores of Messrs. J. Bell and Son, in Southwark Street, to a number of tests, in order to ascertain whether its use in Mills or Factories might contribute to the danger from Fire.

I found that Asbestoline ignites only with the greatest difficulty when brought into contact with flame; that wood and other combustible material soaked in Asbestoline burns, if anything, with greater difficulty than by itself; that its flashing point is so high that it lies beyond the range of Mercurial Thermometers; and that consequently no friction obtainable in the ordinary run of machinery is capable of developing inflammable vapours from it.

Bell's Asbestoline is as absolutely safe a Lubricant as can be desired or obtainable. In the case of fire breaking out from any cause, it does not assist the conflagration; and it is quite incapable of leading to spontaneous combustion, either by itself or in contact with inflammable material.

From the physical nature of Asbestoline its use is of necessity perfectly clean and free from waste.

(Signed) OTTO HEHNER, Public Analyst.

Illustrated Priced Catalogue, with numerous Testimonials by Leading Firms, free on application.

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DEPOTS—MANCHESTER: Victoria Buildings, Deansgate. LIVERPOOL: 2, Strand Street, James Street.

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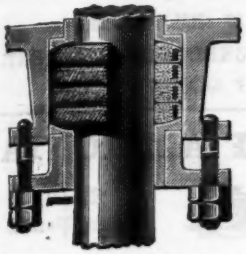
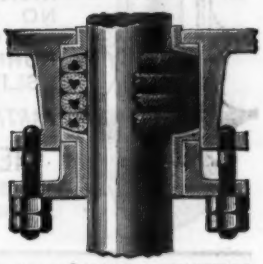


ROUND. SQUARE.



Every 10 feet has Label as above, and bears our Trade Mark.

Under this registered title are included the inventions of Mr. Field; and experience has proved them to be the MOST EFFICIENT, DURABLE, and ECONOMICAL PACKINGS ever made. They constitute such a combination of Asbestos and India-rubber as secures the maximum of elasticity and heat resistance; and they are, therefore, UNEQUALLED FOR EVERY KIND OF ENGINE. These Packings are being universally used by most of the leading Steamship Companies throughout the world for ordinary Compound, Triple, and Quadruple Expansion Engines of the latest type. The Packings are composed of rolled Asbestos Cloth, but the India-rubber is placed in two forms to suit various cases.

IN ORDERING STATE WHETHER SQUARE OR ROUND IS REQUIRED.

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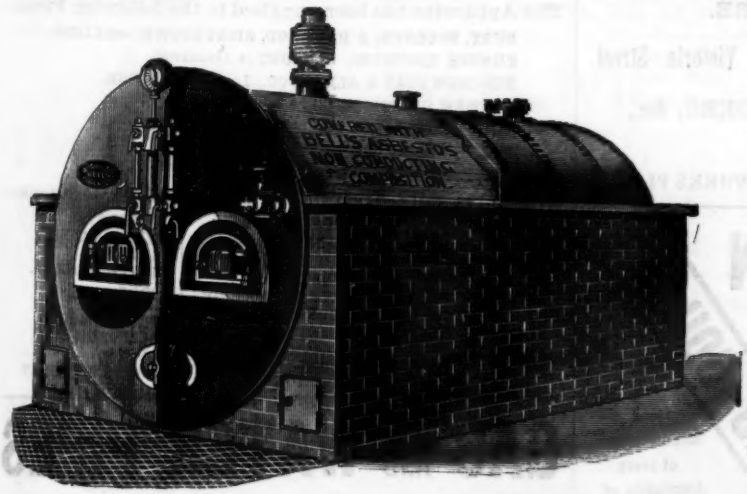
BELL'S ASBESTOS NON-CONDUCTING COMPOSITION,

FOR COVERING BOILERS AND STEAM-PIPES,

Will reduce loss by radiation to a minimum and save 40 per cent. of fuel.



Price 25s. per Cwt.

Second Quality, 15s. per Cwt., is superior to the best sold by other Firms.

It is essential in covering that it shall not only be a non-conductor, but a substance free from whatever can injure metal, and of a nature which will enable it to adhere well for years. To do this it must be sufficiently elastic to prevent cracking and leaving, by expansion and contraction, the heated surfaces to which it is applied. This Composition is daily applied to Tanks with Round or Flat Bottoms, and its adhesive properties enable it to keep to the surfaces without bands or any device necessary for holding on other compositions. Our covering never fails to Save its Cost in a few months, lasts for years, after which it can be taken off and applied again with a little fresh. In all respects it is so superior as to be infinitely cheaper than Compositions sold at one-fourth the price. We would point out that this, being supplied dry in bag, will cover six times more surface than other materials which are sent out wet in cask. This shows the apparent low prices of other Compositions to be a sham.

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NEW HIGH-POWER GAS-LAMP, WESTPHAL'S PATENT.
MOST INTENSE WHITE BRILLIANT GAS LIGHT.
MOST ECONOMICAL, SIMPLE, AND DURABLE.
DOES NOT GET OUT OF ORDER.
RIVALS THE ELECTRIC LIGHT.
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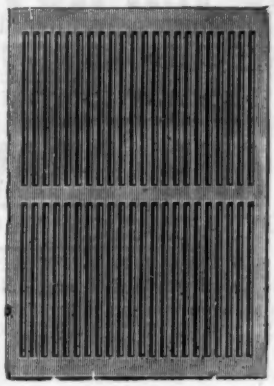

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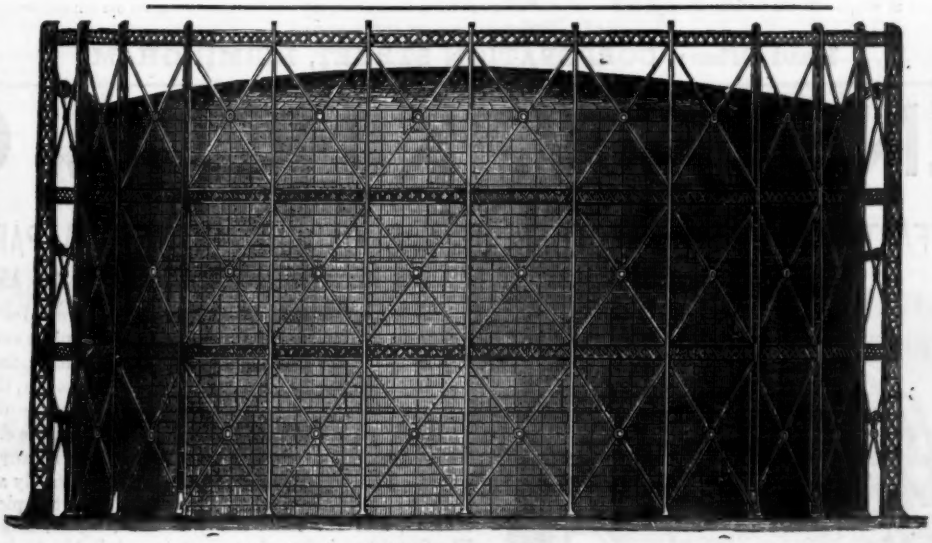

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FOR

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OVER **140** MACHINES AT WORK.

ADVANTAGES ATTENDING ITS USE ARE:—

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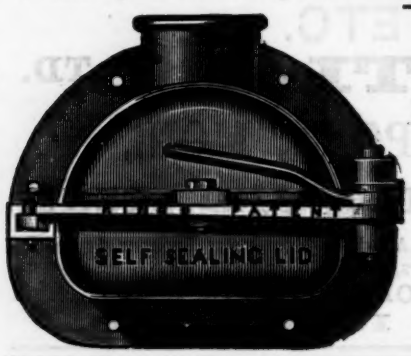
POWER CHARGING AND DRAWING MACHINES, driven by Wire Rope, Steam, or Compressed Air.—The power machines are applicable to circular, oval, or ⌂-shaped retorts and mouthpieces, and are the most perfect, economical, efficient, and durable machines made; they are constructed on principles founded by long and extensive experience in this special branch of gas engineering and the manufacture of gas.



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which, by a simple wedging action at each end of the crossbar, secure a very tight joint; and at the same time, by their long sliding motion, they effectually remove the tar or other matter from the surfaces of the mouthpiece and lid.

N.B.—The whole of these Fittings are made of Wrought Iron.

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A couple of charges of which will clear a stopped pipe, and an occasional charge keeps them clean, and also increases the make per ton and the illuminating power.

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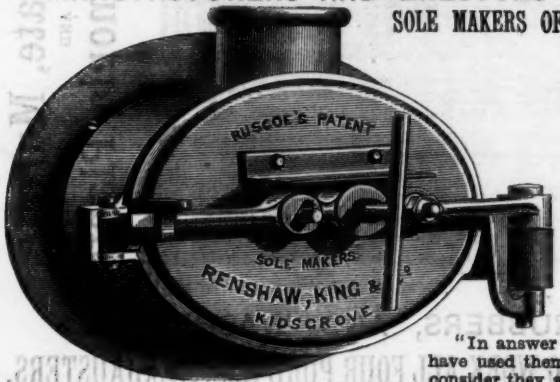
SOLE MAKERS OF RUSCOE'S PATENT SELF-SEALING RETORT LID AND FASTENER.



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"In answer to your inquiry as to Ruscoe's Patent Retort-Lids, we beg to say that we have used them in several works, and are thoroughly satisfied with their action. We consider they are the best in the market.—G. W. STEVENSON & SON."

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